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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	
Filing Date	2012-05-17
First Named Inventor	Richard C. Carlson
Art Unit	TBD
Examiner Name	TBD
Attorney Docket Number	24983US02

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	6917284		2005-07-12	Grisham et al.	
	2	7148791		2006-12-12	Grisham et al.	

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	2012-05-17
	First Named Inventor	Richard C. Carlson
	Art Unit	TBD
	Examiner Name	TBD
	Attorney Docket Number	24983US02

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1	Time Domain's Ultra Wideband, (UWB), Definition and Advantages, 320-0294A, March 2011, pages. 1-14, Huntsville, Alabama	☐

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EXAMINER SIGNATURE

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	2012-05-17
	First Named Inventor	Richard C. Carlson
	Art Unit	TBD
	Examiner Name	TBD
	Attorney Docket Number	24983US02

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Jeb A. Shookman/	Date (YYYY-MM-DD)	2012-05-17
Name/Print	Jeb A. Shookman	Registration Number	67793

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	COLLISION AVOIDANCE SYSTEM FOR RAIL LINE VEHICLES
First Named Inventor/Applicant Name:	Richard C. Carlson
Filer:	Jeb Anthony Shookman/Julia Villarreal
Attorney Docket Number:	24983US02

Filed as Small Entity

Utility under 35 USC 111(a) Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Utility filing Fee (Electronic filing)	4011	1	95	95
Utility Search Fee	2111	1	310	310
Utility Examination Fee	2311	1	125	125
Pages:				
Claims:				
Claims in excess of 20	2202	4	30	120
Miscellaneous-Filing:				
Petition:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**650**

Electronic Acknowledgement Receipt

EFS ID:	12806879
Application Number:	13474428
International Application Number:	
Confirmation Number:	6724
Title of Invention:	COLLISION AVOIDANCE SYSTEM FOR RAIL LINE VEHICLES
First Named Inventor/Applicant Name:	Richard C. Carlson
Customer Number:	23446
Filer:	Jeb Anthony Shookman/Julia Villarreal
Filer Authorized By:	Jeb Anthony Shookman
Attorney Docket Number:	24983US02
Receipt Date:	17-MAY-2012
Filing Date:	
Time Stamp:	17:35:41
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$650
RAM confirmation Number	4611
Deposit Account	130017
Authorized User	

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Application Data Sheet	24983US02_Application_Data_Sheet_Filed_05_17_2012.pdf	1905817 fb0d7eeb5b84e76afc6b88d315cf715cdcb24ae0	no	5
Warnings:					
Information:					
2		24983US02_Application.pdf	262783 413e756d6f9d00c0ec294a9ee3213ca270976c10	yes	45

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Specification	1	39
	Claims	40	44
	Abstract	45	45

Warnings:					
Information:					
3	Drawings-only black and white line drawings	24983US02_Drawings.pdf	255698 42ff29c48561844d6d02c4e42fb7a34aeb67b284	no	15
Warnings:					
Information:					
4	Oath or Declaration filed	24983US02_Declaration.pdf	313658 a98a1ad1ddd242f743527721d3ce654d42a56e3c	no	2
Warnings:					
Information:					
5	Information Disclosure Statement (IDS) Form (SB08)	24983US02_IDS_SB08a_EFS.pdf	611924 13ee58f1a96393ed3c82857111b070e5ff1f2cc6	no	4
Warnings:					
Information:					
6	Non Patent Literature	24983US02_IDS_NPL_1_Time_Domain_UWB_White_Paper.pdf	1896257 4c01d35705155e2f989f49b69f0cfa141c34a0e1	no	14
Warnings:					
Information:					
7	Fee Worksheet (SB06)	fee-info.pdf	36506 23a7b0dbfa5440b326b86f94fc2575d2419e6029	no	2

Warnings:	
Information:	
Total Files Size (in bytes):	5282643

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New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	24983US02
	Application Number	
Title of Invention	COLLISION AVOIDANCE SYSTEM FOR RAIL LINE VEHICLES	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Applicant Information:

Applicant 1 Remove

Applicant Authority	◉ Inventor	○ Legal Representative under 35 U.S.C. 117	○ Party of Interest under 35 U.S.C. 118

Prefix	Given Name	Middle Name	Family Name	Suffix
	Richard	C.	Carlson	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	Wauconda	State/Province	IL	Country of Residence[i]	US

Citizenship under 37 CFR 1.41(b)[i]	US

Mailing Address of Applicant:

Address 1	1901 Applewood Drive		
Address 2			
City	Wauconda	State/Province	IL
Postal Code	60084	Country[i]	US

Applicant 2 Remove

Applicant Authority	◉ Inventor	○ Legal Representative under 35 U.S.C. 117	○ Party of Interest under 35 U.S.C. 118

Prefix	Given Name	Middle Name	Family Name	Suffix
	Kurt	A.	Gunther	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	Round Lake Heights	State/Province	IL	Country of Residence[i]	US

Citizenship under 37 CFR 1.41(b)[i]	US

Mailing Address of Applicant:

Address 1	2312 Prairie Trail		
Address 2			
City	Round Lake Heights	State/Province	IL
Postal Code	60073	Country[i]	US

Applicant 3 Remove

Applicant Authority	◉ Inventor	○ Legal Representative under 35 U.S.C. 117	○ Party of Interest under 35 U.S.C. 118

Prefix	Given Name	Middle Name	Family Name	Suffix
	Marc	W.	Cygnus	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	Mundelein	State/Province	IL	Country of Residence[i]	US

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	24983US02
	Application Number	
Title of Invention	COLLISION AVOIDANCE SYSTEM FOR RAIL LINE VEHICLES	

Citizenship under 37 CFR 1.41(b) [i]	US		
Mailing Address of Applicant:			
Address 1	214 North Lakeshore Drive		
Address 2			
City	Mundelein	**State/Province**	IL
Postal Code	60060	**Country**[i]	US

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below. For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	23446		
Email Address	mhmpto@mcandrews-ip.com	Add Email	Remove Email

Application Information:

Title of the Invention	COLLISION AVOIDANCE SYSTEM FOR RAIL LINE VEHICLES		
Attorney Docket Number	24983US02	**Small Entity Status Claimed**	☒
Application Type	Nonprovisional		
Subject Matter	Utility		
Suggested Class (if any)		**Sub Class (if any)**	
Suggested Technology Center (if any)			
Total Number of Drawing Sheets (if any)	15	**Suggested Figure for Publication (if any)**	2

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S. C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Enter either Customer Number or complete the Representative Name section below. If both sections are completed the Customer Number will be used for the Representative Information during processing.

Please Select One:	◉ Customer Number	○ US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	24983US02
	Application Number	
Title of Invention	COLLISION AVOIDANCE SYSTEM FOR RAIL LINE VEHICLES	

Customer Number	23446

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, or 365(c) or indicate National Stage entry from a PCT application. Providing this information in the application data sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78(a)(2) or CFR 1.78(a)(4), and need not otherwise be made part of the specification.

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
	non provisional of	61598750	2012-02-14
Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
	non provisional of	61627697	2011-10-17
Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
	non provisional of	61519201	2011-05-19

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button. Add

Foreign Priority Information:

This section allows for the applicant to claim benefit of foreign priority and to identify any prior foreign application for which priority is not claimed. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55(a).

Remove

Application Number	Country [i]	Parent Filing Date (YYYY-MM-DD)	Priority Claimed
			○ Yes ◉ No

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Assignee Information:

Providing this information in the application data sheet does not substitute for compliance with any requirement of part 3 of Title 37 of the CFR to have an assignment recorded in the Office.

Assignee 1 Remove

If the Assignee is an Organization check here. ☐

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	24983US02
	Application Number	
Title of Invention	COLLISION AVOIDANCE SYSTEM FOR RAIL LINE VEHICLES	

Mailing Address Information:			
Address 1			
Address 2			
City		**State/Province**	
Country [i]		Postal Code	
Phone Number		Fax Number	
Email Address			
Additional Assignee Data may be generated within this form by selecting the **Add** button.		Add	

Signature:

A signature of the applicant or representative is required in accordance with 37 CFR 1.33 and 10.18. Please see 37 CFR 1.4(d) for the form of the signature.					
Signature	/Jeb A. Shookman/			Date (YYYY-MM-DD)	2012-05-17
First Name	Jeb A.	Last Name	Shookman	Registration Number	67793

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3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

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6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

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9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

APPLICATION FOR UNITED STATES PATENT

TITLE

COLLISION AVOIDANCE SYSTEM FOR RAIL LINE VEHICLES

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority from the following three U.S. Provisional Patent Applications: (1) No. 61/519,201 filed on May 19, 2011, (2) No. 61/627,697 filed on Oct. 17 2011, and (3) No. 61/598,750 filed on Feb. 14, 2012. The disclosures of these three applications are incorporated by reference herein in their entireties.

FIELD

[0002] Certain embodiments of the present disclosure relate to a collision avoidance system for use in the railroad industry. More particularly, certain embodiments of the present disclosure relate to one or more systems, methods, techniques and/or solutions that monitor the location of and separation distance between rail line vehicles, for example, railroad maintenance vehicles.

BACKGROUND

[0003] Railroad companies must perform maintenance on their tracks and other infrastructure associated with their rail lines. The railroad companies employ many different types of rail mounted vehicles to accomplish such maintenance, and these vehicles can range widely in their size, weight and shape because the vehicles perform a variety of tasks. These vehicles may be employed in one or more work gangs, each work gang including anywhere from four to forty vehicles. As such, many vehicles may be working in close proximity on a single track.

[0004] The speed at which the work gang is traveling, and each vehicle within the gang, can vary widely at any given time. For example, the work gang may be traveling to a work site, in which case the work gang, and each vehicle, is traveling at a higher rate of speed than when the vehicles are working at a worksite. When the vehicles are working at a work site, each vehicle is generally traveling at a lower rate of speed or not at all. Within a work gang, the speeds of the vehicles may vary depending on the task that each vehicle is performing.

[0005] Railroads have had several severe collisions and other accidents, some resulting in fatalities, when adequate spacing has not been maintained between rail mounted vehicles. Railroad companies now require that a specific spacing be maintained between vehicles when traveling to/from work sites and when working at a work site.

BRIEF SUMMARY

[0006] One or more systems, methods, techniques and/or solutions are provided for a collision avoidance system for use in the railroad industry that may monitor the location of and separation distance(s) between rail line vehicles, for example railroad maintenance vehicles, substantially as shown in and/or described in connection with at least one of the figures, as set forth more completely in the claims.

[0007] These and other advantages, aspects and novel features of the present invention, as well as details of an illustrated embodiment thereof, will be more fully understood from the following description and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIGS. 1A-1C depict illustrations of example rail line vehicles that may utilize a collision avoidance system, in accordance with one or more embodiments of the present disclosure.

[0009] FIG. 2 depicts illustrations of example rail line vehicles that may utilize a collision avoidance system, in accordance with one or more embodiments of the present disclosure.

[00010] FIG. 3 depicts an illustration of an example collision avoidance system, in accordance with one or more embodiments of the present disclosure.

[00011] FIG. 4 depicts an illustration of an example collision avoidance system, in accordance with one or more embodiments of the present disclosure.

[00012] FIG. 5 depicts an illustration of an example collision avoidance system, in accordance with one or more embodiments of the present disclosure.

[00013] FIG. 6 depicts a block diagram of an example vehicle mounted module, in accordance with one or more embodiments of the present disclosure.

[00014] FIG. 7 depicts a block diagram of an example control electronics module, in accordance with one or more embodiments of the present disclosure.

[00015] FIG. 8 depicts an illustration of side angled view of the upper portion of an example rail line vehicle and an example component mounting configuration, in accordance with one or more embodiments of the present disclosure.

[00016] FIG. 9 depicts an illustration of an example rail line vehicle, including a vehicle mounted module, in accordance with one or more embodiments of the present disclosure.

[00017] FIG. 10 depicts a block diagram illustrating example Ultra Wideband units, in accordance with one or more embodiments of the present disclosure.

[00018] FIG. 11 depicts an illustration of a side view of an example rail line vehicle including multiple Ultra Wideband units, in accordance with one or more embodiments of the present disclosure.

[00019] FIGS. 12A and 12B depict illustrations of example user interfaces, in accordance with one or more embodiments of the present disclosure.

[00020] FIG. 13 depicts a flow diagram that shows exemplary steps in the operation of a collision avoidance system, in accordance with one or more embodiments of the present disclosure.

[00021] FIG. 14 depicts a flow diagram that shows exemplary steps in the operation of a collision avoidance system, in accordance with one or more embodiments of the present disclosure.

[00022] FIG. 15 depicts a flow diagram that shows exemplary steps in the operation of a collision avoidance system, in accordance with one or more embodiments of the present disclosure.

DETAILED DESCRIPTION

[00023] Previous systems for preventing collisions of rail line vehicles have typically utilized a single sensor, for example a GPS or radar-based sensor, to monitor the approximate location of rail mounted vehicles. A shortcoming of single sensor systems, such as ones that depend on GPS sensors, is that the rail vehicles being monitored often enter into "blackout" areas (for example, around buildings, in the mountains, canyons, around sharp curves or in tunnels) where the single sensor may be unable to accurately determine the vehicle's location. For example, a GPS sensor may be unable to communicate with satellites when the vehicle is in a tunnel. Some previous systems attempted to solve this problem by performing a simple "dead reckoning" calculation, where the last known speed and direction of the vehicle are used to estimate the current position of the vehicle until the sensor signal is reestablished. This estimation calculation may not be precise enough to prevent collisions in work gangs because of the speed variation between vehicles. When the vehicles are traveling to a work site, the higher speeds introduce the risk of collision, and when the vehicles are working at a work site, the vehicle are frequently stopping and starting, and this variation in speed between vehicles renders the dead reckoning approach an unsuitable approximation.

[00024] A limitation of radar-based sensors in particular is that they may initiate numerous false positives (warning alarms that are not warranted). With the normal clutter of maintenance operations (people, equipment, trains on adjacent tracks, trackside structures, trestle sides, tunnel walls), radar-based sensors can become confused as to when vehicles are actually in danger of colliding. More specifically, radar-based sensors must deal with the following dilemma: the sensor must scan a wide enough field so that it can detect collision risks when vehicles are traveling on curves at higher speeds, yet as radar-based sensors scan wider fields, they become more susceptible to false detections, for example because the sensor also senses clutter. False detections can result in a dangerous work environment, especially if operators become immune to warnings.

[00025] The present disclosure describes a collision avoidance system (CAS) for rail line vehicles that may utilize a combination of sensor technologies, including an Ultra Wideband (UWB) sensing technology, to counter the limitations of previous systems, and to significantly reduce the potential for vehicle collisions and to enhance the safe operation of a variety of railway vehicles. The present technology is designed to reliably track the location and speed of railway vehicles, as well as the distance between vehicles over a wide variety of track and terrain conditions. The present technology may monitor the separation distance between rail line vehicles

by utilizing sensors that are mounted on each vehicle in a group or work gang, where a work gang may comprising a plurality of railway vehicles, including railway maintenance equipment.

[00026] The CAS may perform the techniques and/or solutions described herein for a wide variety of railway vehicles, for example, railway maintenance equipment / vehicles, railcars, hyrail vehicles, train cars, train engines and other rail line vehicles. FIGS. 1A-1C depict illustrations of types of example rail line vehicles (vehicles 102, 104, 106) that may utilize a CAS or that a CAS as described herein may track. FIGS. 1A and 1B may depict example rail line maintenance vehicles and FIG. 1C may depict an example hyrail vehicle. FIG. 2 depicts illustrations of more example rail line vehicles (vehicles 202, 204) that may utilize a CAS or that a CAS system may track, and also shows an exemplary safe distance 206 between the two vehicles 202, 204. The CAS may track vehicles such as the ones depicted in FIGS. 1 and 2 (and others) over a wide range of terrain (e.g., mountains, canyons, hills, trees, tunnels, curves and trestles) and during a variety of weather conditions (e.g., rain, fog, snow, ice, bright sunlight).

[00027] The CAS may be designed to introduce redundancy into the system, for example in the form of multiple types of sensor technologies and/or multiple sensors of a particular type of technology. One benefit of utilizing redundant sensors may be that some sensors may function properly when other sensors are not functioning optimally or at all. Another benefit of utilizing redundant sensors is that different sensors may be adapted to sense objects and different distances and to different levels of accuracy. In some embodiments, a CAS may utilize a combination of distance sensors so that the CAS is adapted to detect vehicles that are either close or far away, and so that the CAS may detect vehicle separation to within a few inches if the vehicles are close.

[00028] Various embodiments of the present disclosure enable a rail line vehicle having a vehicle mounted module. The vehicle mounted module may comprise a transponder sensor module that includes an ultra wideband unit and a wireless communications antenna. The ultra wideband unit may be operable to detect a distance between the rail line vehicle and at least one other vehicle. The wireless communications antenna may be operable to send and receive data over the air. The vehicle mounted module may further comprise a control electronics module that includes a processor that is in communication with at least the ultra wideband unit. The vehicle mounted module may further comprise a user interface module including a user interface. The user interface may be operable to provide a vehicle operator with information and may be operable to accept input from the vehicle operator. The vehicle mounted module may be in communication with one or more central tracking units by way of the wireless communications antenna. The one or more central tracking units may be operable to track the location of the rail line vehicle and at least one other vehicle.

[00029] In some embodiments, the vehicle mounted module further comprises a central tracking unit module that is operable to track the location of at least one other vehicle. In some embodiments, the vehicle mounted module may be operable to utilize information generated by the global positioning system and the ultra wideband unit to determine whether one or more vehicle separation criteria are violated, and generate a warning if one or more vehicle separation criteria are violated. In some embodiments, the vehicle mounted modules comprises one or more additional transponder sensor modules. The vehicle mounted module may be operable to accept calibration information regarding the length of the rail line vehicle and the mounting locations of the transponder sensor module and the one or more additional transponder sensor modules.

[00030] In some embodiments, the transponder sensor module further includes a global positioning system. The global positioning system may be operable to receive information from one or more satellites and may be operable to determine the absolute position of the rail line vehicle. In some embodiments, the transponder sensor module further includes one or more of a laser device, a radar sensor and an infrared sensor. In some embodiments, the vehicle mounted modules may comprise an additional ultra wideband unit, wherein an offset exists between the ultra wideband unit and the additional ultra wideband unit once the two units are mounted on the rail line vehicle. In some embodiments, the ultra wideband unit is adapted to transmit and receive signals with varying center frequencies.

[00031] In some embodiments, the user interface module further includes a service interface that may be operable to allow the vehicle operator to configure, calibrate, service, maintain, diagnose, update and/or install information on vehicle mounted module. In some embodiments, the user interface is a touchscreen including a screen. The touchscreen may be operable to display one or more screens, menus, options and/or functions, and accept user input from the vehicle operator by allowing the vehicle operator to touch the screen of the touchscreen.

[00032] In some embodiments, the control electronics module further includes one or more interfaces that may be operable to communicate with ground speed detection modules. The ground speed detection modules may include one or more of a microwave radar, a laser device, an infrared sensor and an ultra wideband sensor. In some embodiments, the control electronics module further includes one or more inertial measurement units. In some embodiments, the control electronics module further includes an inertial measurement unit.

[00033] In some embodiments, the vehicle mounted module may be operable to utilize a progressive warning feature that generates a warning if one or more vehicle separation thresholds are violated. The rate, frequency, prominence and/or severity of the warning may increase as the violation of the vehicle separation threshold becomes more critical. The progressive warning

feature may utilize an adaptive threshold feature that modifies the one or more vehicle separation thresholds based on the speed of the rail line vehicle and the speed of one or more nearby vehicles. In some embodiments, the vehicle mounted module may be operable to utilize a stopping distance calibration feature that measures a stopping distance. The stopping distance may indicate how quickly the rail line vehicle can stop under current conditions. The measured stopping distance may be used to modify one or more safe separation distance thresholds.

[00034] Various embodiments of the present disclosure enable a collision avoidance system for rail line vehicles that may comprise one or more vehicle mounted modules, each mounted on a vehicle. Each vehicle mounted module may comprise a transponder sensor module including an ultra wideband unit and a wireless communications antenna. The ultra wideband unit may be operable to detect a distance between the vehicle on which the vehicle mounted module is mounted and at least one other vehicle. The wireless communications antenna may be operable to send and receive data over the air. Each vehicle mounted module may comprise a control electronics module including a processor that is in communication with at least the ultra wideband unit. Each vehicle mounted module may comprise a user interface module including a user interface. The user interface may be operable to provide a vehicle operator with information and may be operable to accept input from the vehicle operator.

[00035] The collision avoidance system that may comprise a central tracking unit that is in communication with the one or more vehicle mounted modules. The central tracking unit may be operable to track the location of the one or more vehicle mounted modules. In some embodiments, the central tracking unit may be distributed among the one or more vehicle mounted modules, wherein each of the one or more vehicle mounted modules includes a central tracking unit component. Each central tracking unit component may be in communication with the vehicle's control electronics module. In some embodiments, the central tracking unit may be disposed in a discrete housing.

[00036] In some embodiments, the transponder sensor module further includes a global positioning system. The global positioning system may be operable to receive information from one or more satellites and may be operable to determine the absolute position of the vehicle mounted module. Each vehicle mounted module may be operable to utilize information generated by the global positioning system, the ultra wideband unit and the central tracking unit to determine whether one or more vehicle separation criteria are violated, and generate a warning if one or more vehicle separation criteria are violated.

[00037] FIG. 3 depicts an illustration of an example collision avoidance system (CAS) 300 for rail line vehicles according to one or more embodiments of the present disclosure. For example

purposes only, FIG. 3 depicts a work gang including only two vehicles 302, 304. In this embodiment, the CAS 300 includes four main types of components – transponder sensor modules (TSMs) (for example, TSMs 306, 308), control electronics modules (CEMs) (for example, CEMs 310, 312), user interface modules (UIMs) (for example, UIMs 314, 316) and a central tracking unit (CTU) (for example, CTU 318). Referring to a single vehicle (vehicle 302 for example), modules that are located in or on the vehicle (for example, TSM 306, CEM 310 and UIM 314) may collectively be referred to as the vehicle mounted module (VMM), even though the individual modules and related components may or may not be housed within a unitary package / enclosure.

[00038] In some embodiments, the VMM components may not be installed on vehicles at production. In these examples, the VMM components may be designed to allow retrofitting into existing railway vehicles without requiring heavily intrusive installation.

[00039] The CAS may include a central tracking unit (CTU), for example the CTU 318 of FIG. 3. The CTU may operate to centrally track all the vehicles in one or more work gangs. The CTU may adapt a tracking software and/or system to monitor individual vehicles. The CTU may include technology adapted to dynamically define which vehicles are in a work gang, and/or which vehicles the CTU should keep track of. The CTU may accept information from VMMs mounted inside vehicles in the work gang, information such as location, speed, separation distance and the like. The CTU may have the ability to analyze and/or store various types of data about vehicles in one or more work gangs. For example, the CTU may analyze absolute and relative positioning data and speed data from vehicles in the work gang. In some examples, the CTU may determine if a separation distance between two vehicles has been violated, indicating that an accident may be likely. Additionally, the CTU may track alarm status of the vehicles in a work gang so that the central tracking unit becomes aware when an accident may have occurred. In another example, the central tracking unit may track data regarding accidents.

[00040] In the embodiment depicted in FIG. 3, the CTU 318 may be located in a discrete housing 320 (also referred to as a module, unit, bungalow or the like). It should be understood that the technology and features of the CTU need not reside in such a discrete housing 320 and may be distributed amongst the vehicles in the work gang, for example with a CTU module / component in each VMM. In embodiments where the CTU is located in a housing 320 that is discrete from the vehicles, the VMM may include a TSM, CEM, and UIM. In embodiments where the CTU is distributed amongst the vehicles, the VMM may further include a CTU module / component.

[00041] FIG. 4 depicts an illustration of an example collision avoidance system (CAS) 400 according to one or more embodiments of the present disclosure. In this embodiment, the system 400 does not include a discrete housing for the CTU technology. This embodiment still utilizes

technology, functionality and features similar to those employed in a system (such as the CAS 300 of FIG. 3) with a CTU disposed in a discrete housing. In this embodiment, the functionality and intelligence of the CTU is dispersed and/or distributed among the VMMs (for example VMMs 402, 404) in the vehicles within a work gang. With this dispersed design (also referred to as "dispersed thinking"), each VMM includes its own CTU module / component that tracks the location of other vehicles in the work gang, like a CTU disposed in discrete housing would do. It should also be understood that although this embodiment describes a central tracking unit component, the central tracking unit circuitry and technology may be incorporated into other components/subcomponents of the VMM, such as the CEM.

[00042] For example purposes, FIGS. 3 and 4 each show a work gang including only two vehicles, but it should be understood that work gangs may include more than two vehicles. FIG. 5 depicts an illustration of an example collision avoidance system (CAS) 500 with a work gang that includes more than two vehicles, according to one or more embodiments of the present disclosure. In this embodiment, each vehicle (for example, vehicles 502, 504, 506) in the work gang may be equipped with a VMM and each VMM may communicate with nearby VMMs (in nearby vehicles) as well as with a CTU 518 in a discrete housing, as can be seen in FIG. 5. In other embodiments of the present disclosure, each vehicle in a work gang is equipped with a VMM and each VMM communicates with nearby VMMs (in nearby vehicles) including a CTU module / component within each VMM (not depicted in FIG. 5). In these embodiments, there may be no CTU in a discrete housing such as the CTU 518 depicted in FIG. 5. FIG. 5 depicts a work gang with three vehicles, but it should be understood that a work gang may include more than three vehicles. As the size of the work gang becomes larger, the VMM mounted on each vehicle may communicate with more VMMs (in nearby vehicles), as well as with the CTU in a discrete housing (or a CTU module / component within the VMMS in each vehicle).

[00043] FIG. 6 depicts a block diagram of an example vehicle mounted module (VMM) 600, in accordance with one or more embodiments of the present disclosure. The VMM may include one or more control electronics modules (CEM) 602, one or more transponder sensor modules (TSM) 604, and one or more user interface modules (UIM) 606. The TSM 604 may further include a wireless communications antenna 608 (for example an RF antenna such as a 2.4 GHz radio antenna) that is operable to send and receive data over the air, for example to/from remote systems. The TSM 604 may further include a GPS unit 610 one or more vehicle communication devices 612. The UIM 606 may further include a user interface 614, a service interface 616 (optionally including diagnostics components / interfaces) and status / fault indicators 618. Additionally, the VMM 600 may receive power from a power supply 640 that may provide

power to one or more vehicle mounted module components, for example components disposed within the CEM 602.

[00044] Wireless communications antenna 608 may be, for example, an RF antenna such as a 2.4 GHz radio antenna. As depicted in FIG. 6, a VMM 600 may communicate with a CTU 630 (for example a CTU located in a discrete housing or a number of CTU modules located in other VMMs) through a wireless communications antenna 608. The wireless communications antenna 608 may be housed in the TSM, or it may be housed separately and perhaps connected to CEM 602 independently. The circuitry for the radio associated with the wireless communications antenna 608 may be disposed in the TSM 604, or may be disposed in the CEM 602 and be connected to the wireless communications antenna 608 via a wired connection. The VMM 600 may transmit a variety of information to the CTU 630, for example, absolute position data, relative position data and speed data of the vehicle. Such information may have been obtained by the VMM utilizing various components and/or sensors, for example, the GPS unit 610, the UWB unit 620, and/or other sensors. The VMM 600 may transmit other information to the CTU 630, for example, status/fault and/or diagnostic information regarding the health of the VMM and its components. The VMM 600 may gather data from one or more satellites 634 utilizing a GPS unit 610, for example to acquire absolute positioning information. The VMM 600 may communicate with other CAS/VMM-equipped vehicles through one or more vehicle communication devices 612 and/or through a wireless communications antenna 608. In some embodiments, the vehicle communications devices 612 may include one or more separate wireless communications antennas (and perhaps associated radios) from antenna 608.

[00045] Referring to FIG. 6, in some embodiments, a CAS may not include a discrete CTU such as the one shown in FIG. 6 at CTU 630. In these embodiments, the VMM may include a CTU module / component 631 that tracks the location of (and provides location information to) other vehicles in the work gang by communicating with other CAS/VMM-equipped vehicles directly. The CTU module / component 631 may operate like (and include similar technology to) a discrete CTU (such as CTU 630) would operate in other embodiments. The CTU module / component may include technology adapted to dynamically define which vehicles are in the work gang, and/or which vehicles the CTU module / component should keep track of. It should also be understood that although the foregoing describes a CTU module / component, the CTU circuitry and technology may be incorporated into other modules, components and subcomponents of the VMM, such as the CEM. In some embodiments, the CTU module / component may be a software feature that is executed by a processor in the CEM.

[00046] VMM subcomponents (for example, the components included within the TSM, CEM and UIM) may be packaged together within a single enclosure. For example, in some embodiments, the CEM and UIM (and optionally, the CTU module) may be combined / disposed in a single package. One benefit of a single package may be that it simplifies the installation process. In alternate embodiments, or one or more VMM components and/or subcomponents may be packaged separately from the other components/subcomponents. The various components and/or subcomponents may be located separately, optionally within separate enclosures, and each separate component may be connected to a main VMM enclosure and/or to other VMM enclosures via wires or a short range wireless link. For example, wireless communications antenna 608 and/or one or more vehicle communication devices 612 may be mounted separately (optionally, in one or more enclosures) on the upper extremity of the vehicle, for example to reduce signal interference and to allow for proper antenna placement (see FIG. 8). Likewise, the user interface 614 may be located in the crew area or the passenger cab. The number of physical packages / enclosures included in each VMM and the mounting location of each package / enclosure may depend on the type (height, length, etc.) of vehicle the VMM is mounted on, or may depend on the configuration of the VMM. In one example, all of the components of the vehicle mounted module are housed within a single weatherproof enclosure. In another example, the wireless communications antenna (for example, wireless communications antenna 608) (or the entire wireless communications radio including the antenna) may be installed at a distance from other VMM enclosures / components to avoid interference between the wireless communications antenna and other components of the VMM, for example the UWB sensor.

[00047] FIG. 7 depicts an illustration of a block diagram of an example control electronics module (CEM) 700, in accordance with one or more embodiments of the present disclosure. The CEM 700 may include a processor 702, a wireless communications radio 704 (such as an RF radio), an interface to a TSM 730, an interface to a UIM 720, one or more interfaces 706 to ground speed detection modules, a power supply interface / power conditioning system 708, and a real-time clock 714. Examples of ground speed detection modules that may connect to interface 706 include an encoder module 750, a microwave radar 752 and/or a laser device 754. The interface to the UIM 720 may further include one or more drivers to power visual and/or audio indicators. In some embodiments, the CEM 700 may include one or more vehicular interfaces (interfaces to existing vehicle systems), for example a CAN interface, braking systems, speed indicators, equipment operating mode status indications and the like. The CEM 700 may include an inertial measurement unit 710 that includes one or more devices, for example, one or more accelerometers and/or gyroscopes. The CEM 700 may include a log/memory 712.

[00048] It should be understood that although FIG. 7 depicts some or all of the aforementioned subcomponents as being contained within the CEM 700, different configurations of the VMM are contemplated by this disclosure, including various combinations of VMM components / enclosures. Therefore, in some embodiments, the subcomponents depicted in FIG. 7 may be disposed outside of the CEM 700, for example in one or more other VMM enclosures. And in other embodiments, subcomponents other than those depicted in FIG. 7 may be disposed inside of the CEM 700, for example one or more subcomponents that may reside in other VMM enclosures in other embodiments. In some examples, some of the subcomponents depicted in FIG. 7 may reside in the UIM and/or the TSM and may connect to the CEM by way of wires or wireless connection(s).

[00049] Referring again to FIG. 7, CEM 700 may include a processor 702. The processor 702 may, among other operations, process information received from the vehicle communication devices, for example via the interface to the TSM 730. For example processor 702 may be in communication with and process information from a UWB unit via TSM interface 730. The processor 702 may also process information received from other modules, components and/or subcomponents of the VMM. The processor 702 may handle information and/or perform computations to, among other things, track other vehicles in a work gang and determine which vehicles present a potential hazard. It should be understood that the CTU may also process location and speed information from vehicles in a work gang and may also track vehicles in a work gang to determine when collisions may be imminent. The present disclosure contemplates various types of configurations whereby some or all of the tracking and processing components of the CAS may be located within the VMMs (for example, within a CTU module), within a CTU in a discrete housing, or a combination of both. In the example where a CTU module / component performs tracking of other vehicles, a CTU module 703 may be disposed within the CEM 700, perhaps implemented in processor 702. In some embodiments, the CTU module 703 may be a software feature that is executed by the CEM processor 702.

[00050] CEM 700 may include an inertial measurement unit 710 that includes one or more devices, for example, one or more accelerometers and/or gyroscopes. The inertial measurement unit 710 may be operable to, among other functions, detect changes in the speed of a traveling vehicle. Detecting changes in vehicle speed may be useful to aid in dead reckoning solutions instead of or in conjunction with short range distance measurement sensors. For example, if a vehicle travelled into a tunnel and the GPS unit could not establish a connection to satellites to provide positioning information, an inertial measurement unit may provide information regarding whether vehicles in a work gang have changed speeds while in the tunnel. An inertial

measurement unit 710 may also be operable to detect sudden changes in speed, for example indicating that a vehicle was involved in a collision, or perhaps indicating some other event. The inertial measurement unit 710 (or some other VMM component) may then store/log data regarding the activities of the vehicle (and/or VMM components) surrounding the time of the event, similar to the way a flight recorder records events proximate to a plane crash. This recording component may collect information from the inertial measurement unit 710 and/or from other VMM components, for example from a UWB unit.

[00051] CEM 700 may include a real-time clock 714. The real-time clock 714 may provide accurate (optionally, synced) time readings, for example to facilitate development evaluation testing. The time and date of the real-time clock may be adjusted automatically, for example by receiving updates from a GPS unit via TSM interface 730. The time and date of the real-time clock may be adjusted by receiving change requests from the service interface or user interface via UIM interface 720. In one example, the real-time clock 714 may exhibit an accuracy of plus/minus 5 seconds per day at 25 degrees Celsius.

[00052] The CEM 700 may be mounted in or near the vehicle cab. For example, if the CEM 700 is packaged with a UIM, the CEM may be mounted in the cab near an operator. In other examples, the CEM may be mounted on an upper frame or part of the vehicle, for example within the vicinity of the TSM. For example, if the CEM is packaged with one or more components of the TSM, a higher mounting location may reduce interference for TSM modules, for example the GPS unit and/or UWB unit. The CEM may be packaged with the TSM in shorter vehicles for example. In some embodiments, it may be beneficial to package the CEM separately from the TSM. In one particular example, the CEM may be mounted directly below the TSM, were the TSM is disposed above or on the roof of the vehicle (see FIG. 8) and the CEM is disposed below the roof of the vehicle, for example fixed to the inner ceiling of the vehicle. In this example, the CEM may be sheltered from direct exposure to sunlight and the components of the TSM may experience minimal interference and a clear line of sight.

[00053] The CEM 700 may interface (for example via a power supply interface 708) with a power supply 760. The power supply interface 708 may include a power conditioning system. In one example, all power for the VMM components and subcomponents passes through the power supply interface / conditioning system 708 located in the CEM, and then power for the other VMM components is routed out from the CEM. In other examples, one or more VMM components may include their own power conditioning systems and may accept power from a power supply without receiving power that is channeled through the CEM. The power supply may be the same as the vehicle's power supply, for example a 12VDC or 24VDC power supply. Alternatively or in

addition, the VMM may include an independent power supply such as a battery, solar panels, and the like.

[00054] Referring again to FIG. 6, VMM 600 may include a transponder sensor module (TSM) 604. In some implementations of the VMM, one or more components of the TSM 604 may be packaged with the CEM 602. In other implementations, it may be beneficial to package one or more TSM components separately from other VMM components, for example on an upper extremity of a vehicle. FIG. 8 depicts an illustration of side angled view of the upper portion 802 of an example rail line vehicle (for example a vehicle similar to the vehicle of FIG. 1C) and a mounting configuration 804 for one or more components of a TSM, in accordance with one or more embodiments of the present disclosure. One or more TSM components may be mounted at a high point (for example, the highest point) on the vehicle, where a clear line of sight may be established between the TSM components and an area to the front and rear of the vehicle.

[00055] In the example shown in FIG. 8, the wireless communications antenna 806 (for example, similar to the wireless communications antenna 608 of FIG. 6) and a UWB unit 808 (for example, similar to the UWB unit 620 included in the one or more vehicle communication devices 612 of FIG. 6) may be mounted separately from other VMM enclosures. In this example, the wireless communications antenna 806 and UWB unit 808 may be mounted on the upper extremity 810 of the vehicle to reduce signal interference and to allow for proper antenna placement. It should be understood that FIG. 8 depicts only one example of TSM components that may be mounted on the upper extremity of a vehicle. More or less TSM components (or other VMM components) than are shown in FIG. 8 may be mounted on the upper extremity of a vehicle. For example, components that may be mounted on the upper extremity of a vehicle may include the UWB unit, wireless / RF antennas and/or radios, GPS units, infrared sensors and the like.

[00056] TSM components (and/or other VMM components) may be installed on the upper extremity of a vehicle by a variety of means. Referring to FIG. 8, for example, a hole may be drilled through the side of an upper portion 802 of a vehicle or through the roof 810 to allow hardware to thread through the vehicle's upper portion 802 and also through VMM components to fix the components to the upper portion. Additionally, brackets, flanges, sockets or other hardware may be used to fix components to the upper portion 802. For example, FIG. 8 shows a bracket 814 that may be used to fix a UWB unit to the upper portion 802. The bracket 814 may be fixed to the upper portion 802 of a vehicle and the UWB unit may be fixed to the bracket. Brackets may aid in attaching components to the upper portion 802, and/or they may elevate components so that the components experience increased line of sight and decreased interference. One or more holes may

be drilled through the roof 810 or a side wall of upper portion 802 to allow the passage of interface cables (for example, cable(s) 812 of FIG. 8) into and/or out of the cab of a vehicle.

[00057] FIG. 9 depicts an illustration of an example rail line vehicle 900, including a VMM that includes more than one TSM, in accordance with one or more embodiments of the present disclosure. In some embodiments of the disclosure, the VMM in a rail line vehicle may include more than one TSM, or may include more than one group of TSM components mounted on the upper extremity of a vehicle. With regard to the disclosure herein, when a description explains the configuration and/or benefits of multiple TSMs, it should be understood that the entire TSM may not be duplicated. Instead, one or more components of the TSM may be duplicated, while there may be a single instance of other components of the TSM. For example, the VMM may include duplicated vehicle communication devices, such as two or more UWB units. Additionally, while the disclosure herein may describe two TSMs, some embodiments may include VMMs with more than two TSMs.

[00058] Referring to FIG. 9, a VMM installed in a vehicle 900 may include two TSMs 902, 904 (or two groups of some TSM components), for example mounted at either end of the vehicle 900. As shown in the example of FIG. 9, the two TSMs 902, 904 may be mounted at the extreme (or near extreme) front and rear ends of the vehicle 900. Placing sensors, for example sensors included in TSMs 902, 904, at the extreme ends of a vehicle may improve the accuracy of some sensors, for example sensors that measure distance between vehicles (such as UWB sensors or infrared sensors). Especially if the vehicle 900 is long, a distance sensor (for example a sensor included in TSM 904) that is placed near the end of a vehicle may more accurately calibrate itself to determine the exact location of the end of the vehicle 900, and thus the sensor may be able to determine more accurately the distance between the end of the vehicle 900 and other vehicles. The two TSMs 902, 904 may be connected to a single CEM 906, which may be connected to a single UIM 908. In other embodiments, the VMM may include more than one CEM and/or more than one UIM.

[00059] When a VMM-equipped vehicle is initialized to operate with a CAS, the VMM components of the vehicle may be calibrated (also referred to as "commissioning" the vehicle) to the particular installation configuration for that vehicle. Calibration may include an operator specifying the vehicle length in each direction from the one or more mounted TSMs. Rail line vehicles (for example, maintenance vehicles) can range in length (see FIG. 1), for example from 12 feet to 80 feet, and the vehicles can have a variety of cab locations and configurations. Given the different lengths and configurations of vehicles, it may be necessary to program information into various components of the VMM, including the TSM and/or the CEM, such that the components

are aware of (and/or can compute) the distance between the component's mounting location and the ends of the vehicle.

[00060] In some embodiments of the disclosure, circuitry within the VMM (for example in the CEM) may automatically compensate (calibrate) for the length of the vehicle and the mounting location. In one example, the VMM may include a single TSM, and the TSM may be mounted on the vehicle (for example, at the front or center of the vehicle), and circuitry within the VMM (for example in the CEM) may automatically compensating for the length of the vehicle and the mounting location. In another example, the VMM may include multiple TSMs, and the TSMs may be mounted on the vehicle (for example, near the front and rear of the vehicle), and circuitry within the VMM (for example in the CEM) may automatically compensating for the length of the vehicle and the mounting location of the multiple VMMs. The sensors may be designed to adjust for the size of the equipment and specific location of the components. The present disclosure contemplates various methods and solutions to adjust settings of VMM's components at initial installation to aid in component awareness. Components may contain smart technology that aids in the component's calibration. The VMM components may also be operable to account for a length of a vehicle that may change on the fly. For example, some vehicles change length when retractable sections are extended. The VMM components may be designed to accommodate this change in length, either by manual user input or automatic detection of the vehicle configuration.

[00061] Referring again to FIG. 6, the TSM 604 may include one or more vehicle communication devices 612. It should be understood that throughout this disclosure, when reference is made to vehicle communication devices, there may only exist a single vehicle communication device, for example just a UWB unit. In other examples, there may be more than one vehicle communication device. Vehicle communication devices 612 may be packaged together, or they may be packaged independently, or they may be packaged with other TSM components. The vehicle communication devices 612 may be in close communication with the CEM 602 via either a wired connection or a short range wireless connection. One benefit of a wired connection is that the CEM, which may contain a power conditioner unit and an interface to a power supply, can provide power to the vehicle communication devices, along with communication functions.

[00062] The vehicle communication devices 612 may communicate wirelessly with other CAS/VMM-vehicles 638 in the work gang. The vehicle communication devices 612 may be operable to, among other functions, determine the relative location of other CAS/VMM-equipped vehicles in relation to the present vehicle. The vehicle communication devices 612 may utilize one or more communication technologies and may include one or more integrated antennas for sending

and receiving signals to and from other vehicles. In one example, each vehicle may have a unique identification code that was assigned when the VMM was installed in the vehicle, or before or after such installation.

[00063] In some embodiments of the present disclosure, the vehicle communication devices 612 may include an Ultra Wideband (UWB) unit 620 to communicate with other VMMs. In one specific example, the UWB unit 620 is the only vehicle communication device. The UWB unit may include a control board, a data interface and/or a UWB antenna. The UWB unit 620 is typically adapted for sending signals to and/or receiving signals from UWB units mounted on/inside other vehicles. The UWB unit 620 may be adapted to measure the relative separation distance between properly equipped vehicles without becoming confused by interference from nearby stationary or unrelated off-track equipment that might otherwise cause false alarms in radar-based collision avoidance systems.

[00064] FIG. 10 depicts a block diagram illustrating example UWB units, in accordance with one or more embodiments of the present disclosure. Pulses emitted from a UWB transmitter may spread in many directions. A UWB unit may transmit and receive pulses that are communicated directly 1002 between UWB units (for example between a UWB transmitter/transceiver 1008 and a UWB receiver/transceiver 1006), and/or the UWB unit may transmit and receive pulses that have been reflected 1004 (bounced) off of an object and/or surface, for example the ground. A UWB unit may be capable of resolving multipath reflections from a main signal by focusing on the first arriving pulse. Additionally, the UWB technology may take advantage of the fact that radio waves / pulses travel at a particular velocity. By measuring how long it takes a wave / pulse to travel (for example by reflecting / bouncing) between two transceivers, the distance between the UWB units can be accurately determined. This technique may be referred to as "Time of Flight" (TOF). In existing wireless radio technologies, TOF calculations have previously had limitations due to the reflection of radio waves from the wide range of objects in the vicinity. These reflections may result in the receipt of numerous conflicting signals of varying amplitudes, and in some instances one or more signals may cancel each other out, a phenomena referred to as "multi-path distortion". This may result in inaccurate distance determinations because a direct wave may have been cancelled out, and a reflected wave may travel a longer path and appear to be the first arriving pulse, resulting in a false (longer than actual) separation distance measurement.

[00065] A UWB unit may utilize a high bandwidth pulsed distance-measurement technology. A UWB transceiver may utilize a broad spectrum of frequencies simultaneously at a relatively low power levels. A UWB unit may be operable to periodically transmit short duration

pulses, such as RF pulses. For example, a UWB unit may measure a distance of several hundred feet with a resolution of several inches. Precise range determination may be advantageous, for example when vehicle separations are small and/or when a potential GPS measurement error becomes significant. In one example, a GPS measurement error may be 10-15 feet. Additionally, each pulse transmitted by a UWB unit may be coded and the phase of the pulse may be modulated and the pulse repetition rate may be variable. Thus, a UWB unit may measure separation distances more accurately and be less susceptible to interference from geographic conditions and less susceptible to multi-path distortion than are other wireless technologies.

[00066] A UWB unit may transmit one or more signals that may be pseudo-randomly (and uniquely) encoded with low-amplitude RF energy spread over a 2 GHz bandwidth. The transmitted signal may be spread out over such a wide range of frequencies that the transmissions appear like normal background atmospheric noise. As a result, the signal is unlikely to cause interference with other communications systems. This encoding also means that information may be transmitted with the range finding signal, such that data communication may be accomplished while distance measurement is performed. In other words, the UWB unit may be adapted to transmit data to other UWB units in addition to detecting the distance to other UWB units. In effect, the two functions (data and distance) may be performed at the same time using the same wireless link because the UWB unit may transmit data, and then additionally, distance information may be computed by determine how long it took for the data to travel from one UWB unit to the other. It should be understood, however, that the two functions (data and distance) need not be performed at the same time.

[00067] The UWB unit may be adapted to send data as well as determine distance between vehicles. Because the UWB unit may be utilized to send data, some embodiments of the present disclosure, for example those where a central tracking component resides in the vehicle mounted module, may not need to use any other type of wireless or RF technology to communicate. This could reduce the technology components required in the system, reducing cost of the system. However, in other embodiments, a VMM may benefit by utilizing more than one data link (wireless technology capable of transmitting data). For example, a wireless RF link may provide a greater distance / range for sending data than a UWB unit, and because of this benefit and potentially other benefits of various types of data links / wireless technologies, a VMM may benefit by utilizing more than one type of data link. Additionally, a collision avoidance system may have multiple data links in order to introduce redundancy into the system. For example, the UWB unit may be capable of sending data if the RF link is not functioning properly, and vice versa.

[00068] One example of a UWB technology that the CAS may utilize is the technology described in the White Paper published by Time Domain entitled "Time Domain's Ultra Wideband (UWB): Definition and Advantages," which is incorporated by reference in its entirety herein. However, it should be understood that the collision avoidance system may utilize other designs and types of UWB technologies besides just the one described in the White Paper.

[00069] The UWB unit may be operable to measuring the vehicle separation independently. Thus, in various embodiments of the CAS, the UWB unit may replace the GPS unit, or the UWB unit may work in conjunction with the GPS unit. As explained above, the CAS may be designed to include redundancy in the system, for example in the form of multiple types of sensor technologies and/or multiple sensors of a particular type of technology. One benefit of utilizing redundant sensors may be that some sensors may function properly when other sensors are not functioning optimally or at all. For example, a GPS sensor may not communicate well with satellites when a vehicle is in a tunnel, and thus the GPS unit may not provide adequate information to the CAS in this situation. However, in this situation, the UWB unit (or other sensors/technologies) may be fully functional. For example, tests have been performed in tunnels that stretch up to 1 mile in length (or longer), and the tests have shown that a properly configured UWB unit may accurately measure distance and relative speed of vehicles in such a tunnel. UWB sensors (and/or other non-GPS type sensors) may also work in conjunction with a GPS sensor. For example, a UWB sensor may provide better resolution (i.e., can measure separation distance at finer increments, more accurately) and the GPS sensor may provide a location / separation information over a greater area.

[00070] Referring again to FIG. 6, once a UWB unit determines distance information, it may communicate this data to a CTU 630, for example via wireless communications antenna 608. Wireless communications antenna 608 may be an RF antenna, for example a 2.4 GHz radio antenna. In other embodiments, where there is no CTU in a discrete housing, UWB distance data (an optionally other data) may be communicated to CTU modules in other VMMs via wireless communications antenna 608 and/or a separate wireless communications antenna located in the TSM 604. In embodiments where the UWB unit is adapted to operate in conjunction with a GPS unit, combined GPS and UWB distance data may be communicated between a vehicle and the CTU 630 and/or between vehicles in the work group via similar wireless communications antennas / technologies as described herein.

[00071] FIG. 11 depicts and illustration of a side view of an example rail line vehicle including multiple UWB units (or multiple UWB components), in accordance with one or more embodiments of the present disclosure. In some embodiments, a VMM installed on a vehicle 1102 may include more than one UWB unit (for example, UWB units 1104, 1106), for example to

introduce redundancy into the system. In some embodiments, a VMM installed on a vehicle 1102 may include more than one UWB antenna, and the multiple UWB antennas may share a common control board and/or data interface. When present disclosure describes multiple UWB units, it should be understood that the entire UWB unit may be duplicated or one or more components of the UWB unit may be duplicated, for example the UWB antenna. In some embodiments, multiple UWB units (or multiple UWB components) may be housed in a single enclosure. In other embodiments, multiple UWB units (or multiple UWB components) may be housed in separate enclosures, as depicted in FIG. 11.

[00072] In some situations, when a UWB pulse is reflected from an object or a surface (for example the ground), the UWB pulse may be destroyed (for example, by a reflected signal which is the same amplitude but 180 degrees out of phase) or altered before it gets to the UWB receiver, and/or other interference may cancel out a pulse. These situations where a UWB link might not transmit a pulse ideally may be referred to as "holes." In some embodiments, the VMMs may include more than one UWB unit (or UWB component), for example in case one UWB pulse is destroyed. In some examples, two UWB units (or two UWB antennas) may be mounted on a single vehicle with a small offset between the UWB antennas. For example, referring to FIG. 11, two UWB units (or two UWB antennas) 1104, 1106 may be mounted on a single vehicle 1102 with a small vertical distance 1108 between the UWB antennas. In this example, pulses 1110, 1112 from the two UWB units 1104, 1106 (respectively) may arrive at a UWB receiver of another vehicle after traveling slightly different distances (for example, because they reflected off the ground at different angles). Multiple / redundant UWB units may increase the probability that whatever surface and/or interference destroyed or altered one UWB pulse will not interfere with the second UWB pulse. In some examples, two UWB units (or two UWB antennas) may be mounted on a single vehicle with a small horizontal distance between the UWB antennas. The horizontal offset may provide information to the VMM to determine the orientation of nearby vehicles in relation to the immediate vehicle. For example, UWB unit information may show that a nearby/target vehicle that is in front of the immediate vehicle is closer to a front UWB antenna, and likewise for a rear vehicle / rear UWB antenna.

[00073] In some embodiments, one or more UWB units may be operable to transmit/receive signals with varying center frequencies. This multiple center frequency technique may work with a single UWB unit or it may work with multiple UWB units. In a single UWB unit example, the UWB controller may utilize adaptive output filters. The UWB unit may include a single UWB transceiver that is adapted to send multiple pulses/signals with different center

frequencies at different times, for example alternating between modes (center frequencies). A corresponding UWB receiving unit may be synchronized with the UWB unit sending the signals, in that it may receive pulses/signals with different center frequencies at different times. In a multiple UWB unit example, one UWB unit may send signals at one center frequency and another UWB unit may send signals at a different center frequency. Variations in the center frequency of the UWB signals may result in a different phase delays of the signals, for example when reflected. If one signal has been significantly altered or destroyed by a reflection, another signal(s) (which utilizes a different center frequency) may be unaffected, or at least less affected, by the reflection. This may be because different frequency signal(s) over the same reflection path length may experience a different phase delay. This approach may improve the reliability of UWB communications under certain operating conditions.

[00074] Referring to FIG. 6, in some embodiments, the vehicle communication devices 612 may include other wireless communication devices / technologies (beyond or in replacement of a UWB unit) to communicate with other VMMs. In some embodiments, a VMM may utilize a wireless communications antenna/radio (for example, an RF antenna/radio) to communicate with other VMMs. In some embodiments, the same wireless communications antenna 608 that communicates with a CTU 630 may communicate with other VMMs. In some embodiments, the vehicle communication devices 612 may include an ultrasonic or short distance laser device. Some example ultrasonic or short distance laser devices can sense distances between zero and thirty feet. In yet other examples, the vehicle communication devices may utilize radar, infrared (IR), and/or optics technologies.

[00075] Referring again to FIG. 6, a TSM may include a Global Positioning System (GPS) unit 610. The GPS unit 610 may be incorporated to the TSM. In some embodiments, the GPS unit 610 may be packaged with one or more vehicle communication devices 612, or it may be packaged in the CEM. Alternatively, the GPS unit 610 may be housed separately or may be incorporated into other VMM components or subcomponents. The GPS unit may include either an integrated or separate antenna assembly.

[00076] The GPS unit 610 may be adapted to determine the absolute position and speed of a vehicle that is equipped with the GPS unit. Information / data generated by a GPS unit may allow real-time determination of vehicle velocity and location. This information / data may allow a GPS unit 610 to determine expected vehicle stopping distances and may enable logging of equipment location with respect to time and date. For example, absolute location information provided by a GPS unit 610 may be useful to track the work performed by a work gang. A GPS

unit may also provide distance information regarding the distance between two GPS-equipped vehicles.

[00077] Some GPS-based systems may experience reduced accuracy at times or may lose all connection with satellites, for example, when a vehicle enters a deep valley or a tunnel. A GPS unit may provide distance information in conjunction with other technologies that provide distance information (for example, UWB, infrared) as a form of redundancy and/or to offer a variety of distance measurement ranges and precision. A GPS unit may be operable to determine vehicle position within a wider range, for example 10 to 15 feet. A GPS unit may allow for the determination of distances between vehicles that are too far apart for other types of distance detection technologies to function accurately. Then, other technologies, for example a UWB unit, may provide a more precise distance measurement, for example a distance within 6 inches. The accuracy of a GPS unit 610 may be enhanced by utilizing a WAAS (Wide Area Augmentation System), a system of ground reference stations across North America that provide GPS signal corrections. Corrections provided by a WAAS may improve the positioning capability of the GPS unit 610, for example by a factor of five, such that the location may be determined as accurately as within 2 to 3 feet.

[00078] Referring to FIG. 6, the VMM may include one or more user interface modules (UIM) 606. A UIM 606 may further include a user interface 614, a service interface 616 (optionally with diagnostic components/interfaces) and status/fault indicators 618. A UIM 606 may provide an operator with an interface by which the operator can engage with the technologies that are part of the VMM, and by which the operator may be alerted of events, for example if vehicle separation criteria are violated. A UIM may be located / mounted within convenient reach and view of the operator, and may be connected by an interface cable (or short range wireless connection) to other VMM modules, for example the CEM. For example, the UIM may be mounted in a vehicle cab in order to allow the operator to see and hear warning and alarm indications.

[00079] Status / fault indicators 618 may alert an operator that one or more VMM components and/or subcomponents are not operating in an optimal manner. In some embodiments of the present disclosure, the VMM components may be operable to "self-monitor," meaning they may be adapted to monitor their own operation and health. If a VMM detects degraded or non-optimal performance (for example regarding any of the sensors or other VMM components or subcomponents), the status/fault indicators 618 may alert an operator. In some embodiments, the VMM may communicate status/fault indication to the CTU (or CTU module(s), for example via a wireless communications antenna, for example wireless communications antenna 608.

[00080] FIGS. 12A and 12B depict illustrations of example user interfaces, in accordance with one or more embodiments of the present disclosure. The UIM may include a user interface. Referring to FIGS. 12A and 12B, it can be seen that a user interface (for example user interfaces 1202, 1204) may include one or more means of alerting an operator of events, for example if vehicle separation criteria are violated. FIG. 12A shows one example of a user interface 1202. In this example, the user interface 1202 may include one or more visual indicators 1206, one or more audible indicators 1208, one or more switches/buttons 1210, 1212, 1214, and/or other input means or alerting means. Examples of visual indicators 1206 are lights, lamps, alpha-numeric character displays, LED's and the like. These indicators may provide an operator with information regarding the technologies included in the VMM, and certain indicators may alert the operator when an event occurs, for example when separation parameters (between vehicles for example) are exceeded. Examples of audible indicators 1208 are variable characteristic audible indicators, buzzers, alarms, sirens, horns and the like. The user interface 1202 may include one or more interface switches/buttons 1210, 1212, 1214 that may be adapted to allow an operator to configure and/or interact with components of the VMM. For example switches may be adapted to activate and deactivate component interfaces, for example component interfaces in the CEM. In one example, (and referring to FIG. 7), an operator may use a switch to deactivate the interface 706 to an encoder module. Examples of other input switches/buttons are buttons that acknowledge (temporary mute) a buzzer, alarm or a horn.

[00081] FIG. 12B shows another example of a user interface 1204. The user interface 1204 may be a touchscreen, tablet, PDA, monitor or other type of digital display / interface. Even though some descriptions of user interface 1204 may refer to it as a touchscreen, it should be understood that other alternatives mentioned and others may be contemplated. In some embodiments, a touchscreen may be implemented in conjunction with other types of user interfaces or user interface components, for example the components of user interface 1202. In some embodiments, a touchscreen may be adapted to serve as the only user interface component that interfaces with the operator. In some embodiments (and referring to FIG. 6), if a touchscreen is used to implement the user interface 614, other components of the UIM (for example the service interface 616 and/or the status/fault indicators 618) may be incorporated into the same touchscreen.

[00082] User interface / touchscreen 1204 may offer more flexibility and functionality than "hard" switches, lights, buzzers and the like. For example, a touchscreen may include on or more physical buttons (for example button 1218), but may also allow an operator to engage "soft" / temporary buttons on the screen 1216 of the touchscreen. In this respect, the touchscreen may offer similar functionality to hard switches/buttons. Additionally, a touchscreen may include one

or more speakers and/or audio drivers, and thus the touchscreen may offer similar functionality to hard buzzers, alarms and the like. The screen 1216 of the touchscreen 1204 may also alert an operator to an event, offering similar functionally to hard lights, lamps and the like.

[00083] A touchscreen 1204 may be adapted (i.e., programmed, etc.) to display to an operator multiple sets of screens and/or menus, with multiple sets of options, functions and the like. Additionally, a touchscreen may be adapted to display complex (for example, graphical, textual, etc.) information to an operator. For example, a touchscreen may show the operator the speed of his vehicle, or may show operator his GPS coordinates. A touchscreen 1204 may be adapted (i.e., programmed, etc.) to offer additional functionality, for example allowing operators to send messages (for example text-based or html-based message) to nearby vehicles. In some embodiments, a touchscreen may provide a GPS-augmentation feature, for example, which may adapt the touchscreen to display the location of the vehicle relative to railroad mile markers.

[00084] It should be understood that the components and/or functionalities of user interfaces 1202 and 1204 may be incorporated into or implemented in one or more physical housings and/or devices. These components may be incorporated into discrete enclosure(s) (for example mounted near an operator / cab) and/or they may be incorporated into VMM components. In some embodiments, the user interface (for example, interfaces 1202 and/or 1204) may be mounted alongside or in the same enclosure as the CEM 1230 or it may be mounted in a separate enclosure. For example, the user interface may be located in the passenger cab and the CEM may be located on an upper internal extremity of the vehicle. This flexible mounting arrangement may help to accommodate a wide range of equipment / vehicles that the CAS may need to track by allowing the user interface to be mounted where it is visible and accessible to the equipment operator while allowing the CEM to be mounted in close proximity to the TSM, which may improve performance, for example by allowing better reception.

[00085] The user interface (for example user interfaces 1202 and/or 1204) may be in communication with the CEM 1230, and/or other VMM modules. The user interface may communicate with the CEM, for example, via either a wired interface or a short range wireless connection. One benefit of a wired connection is that the CEM, may contain a power supply interface and/or a power conditioner unit and may be able to provide power to the user interfaces, along with communication functions.

[00086] Referring to FIG. 6, the UIM 606 may include a service interface 616 that provides for installation, configuration, maintenance and/or diagnostic activities. The service interface 616 may be incorporated as part of the user interface, or it may be housed separately. In some embodiments, the service interface 616 may be located in the CEM 602. The service interface 616

may also be used to initialize the vehicle mounted module. In other embodiments, the user interface 614 may be used to initialize the vehicle mounted module. For example, the CEM may include a setup program that initializes the various VMM components and subcomponents. An operator may use the user interface 614 or the service interface 616 to input initialization information into the setup program. Such information may include the physical location where various VMM components are mounted on the vehicle, as well as vehicle size and vehicle type. This information may be input when the vehicle mounted module is initially installed on the vehicle.

[00087] The service interface 616 may include a variety of technologies that may enable fast and easy communication between an operator and the service interface, and between the service interface and other VMM components and subcomponents. For example, service interface 616 may include one or more USB ports, Ethernet ports, and/or SD memory card slots. Service interface 616 may be configured, for example, with an industry standard Ethernet port to allow the use of commercially available laptop computers that may interface with service interface 616, for example to perform status inquiries, to configure settings of VMM components, and/or to update the software/firmware of VMM components. Ethernet ports generally will conform to the IEEE 802.3 communication standard for 10BASE-T Ethernet (or alternatively 100BASE-T). In addition to Ethernet ports, or in conjunction with Ethernet ports, the service interface 616 may be configured with an 8-position RJ45 modular jack for interconnection. The service interface 616 may also operate as a DHCP server, thus allowing an operator to connect a laptop to the Ethernet port and within a few seconds be automatically configured and communicating with the VMM 600. Alternatively, the service interface 616 may require a static IP address setting to be configured on the laptop. In such a configuration, the service interface may conform to the Internet Protocol Version 4 (IPv4). In some examples, the service interface connectors, such as the Ethernet connectors and the RJ45 connectors, may include environmental dust shields for protection.

[00088] In some embodiments, service interface 616 may include wireless capabilities. For example, service interface 616 may include a wireless radio (for example an RF radio), WIFI components and/or other wireless technology. A service interface 616 with wireless capabilities may be adapted to accept "field updates." Field updates refer to updates to the software and/or firmware of VMM modules that are "pushed" to the modules over a wireless link. In one example, a foreman may drive up to a group of vehicles and may push updates to all the vehicles simultaneously, for example without having to physically connect to the vehicles. Alternatively or

in addition, wireless communications antenna 608 (and/or other wireless communication antenna(s)) may be used to perform field updates.

[00089] In one or more embodiments of the present disclosure, the VMM may include (or may interface with) one or more non-GPS type sensors. These non-GPS type sensors may be adapted to measure speed (also referred to as ground speed) and direction of a rail vehicle. A GPS unit may provide speed and direction information, but in some embodiments and/or in some situations, the non-GPS type sensors may either supplement or replace GPS speed and direction information. For example, non-GPS type sensors may supplement a GPS sensor as a form of redundancy in the system, or may provide speed and direction information when the GPS unit cannot communicate with satellites (for example, when a vehicle is inside a tunnel). Additionally, these non-GPS type sensors may allow the CAS to determine relative vehicle position. For example, the non-GPS type sensors may calculate relative vehicle position as a function of the offset from the last known GPS location.

[00090] One type of non-GPS type sensor is an encoder module. An encoder module may be adapted to measure ground speed and direction of a rail line vehicle. The encoder module may supplement the UWB technology or replace the UWB technology, for example as a method of providing more precise "dead reckoning" data to the CAS, helping to overcome the "dead reckoning" limitations of earlier systems. In one embodiment, the encoder module may include a small rubber wheel which contacts the top of a rail on which the vehicle travels. The encoder module may be mounted on an adjustable preloaded assembly which maintains contact with the rail. A magnetic rotary encoder may count the rotations of the wheel. In one example, an encoder module may use a small integrated Hall-ASIC to determine the rotational speed of the wheel. This wheel rotation information may be translated into distance information which may be communicated to a CEM either through a wired or wireless connection.

[00091] The encoder module may be adapted to allow the encoder assembly be manually or automatically raised from the tracks for maintenance or lifting of the vehicle from the tracks. The encoder module may also include auto calibration features. For example, as the encoder wheel turns, it may utilize GPS data, when it is available, to review the last distance traveled, and compare that with the number of rotations of the wheel. This information can be constantly updated and used to compensate for wheel wear and or track slippage. Referring to FIG. 7, a CEM 700 may include one or more interfaces such that a VMM may communicate with one or more non-GPS type sensors. An encoder module, for example, may be in communication with a CEM, typically connected to a module interface. As an example, FIG. 7 depicts an encoder module 750 connecting to a CEM 700 via an interface 706.

[00092] Another type of non-GPS type sensor that may be in communication with a VMM is microwave radar, for example a Doppler radar. A microwave radar may be adapted to measure ground speed and direction of a rail vehicle. In one example, a microwave radar may be mounted on a rail line vehicle and may be oriented to point at the ground to detect ground speed and direction of travel. A microwave radar, for example, may be in communication with a CEM, typically connected to a module interface. As an example, FIG. 7 depicts a microwave radar 752 connecting to a CEM 700 via an interface 706.

[00093] Another type of non-GPS type sensor that may be in communication with a VMM is a laser device. A laser device may be adapted to measure ground speed and direction of a rail vehicle. In one example, laser device may be mounted on a rail line vehicle and may be oriented to point at the ground. A laser device may bounce a signal off of the ground (or other stationary object) to detect ground speed and direction of travel. A laser device, for example, may be in communication with a CEM, typically connected to a module interface. As an example, FIG. 7 depicts a laser device 754 connecting to a CEM 700 via an interface 706.

[00094] Other types of non-GPS sensors that may be used in conjunction with the GPS sensor to detect ground speed and direction of travel include infrared sensors, UWB sensors as described herein, UWB radar sensors, and other types of radar sensors. These non-GPS type sensors may add redundancy to the GPS sensor, or they may provide information when GPS information is temporarily unavailable. One or more parts of one or more of the non-GPS type sensors may be packaged in the same enclosure as other VMM modules, or they may be packaged separately.

[00095] In operation, the CAS may be capable of precisely tracking the location and separation distances of vehicles equipped with appropriate equipment and/or components as described herein. When the CAS is tracking vehicles, a particular work gang may be operating in one of two modes for example–travel mode or work mode. For each mode, railroad companies may require that a specific spacing be maintained between vehicles. In work mode, the vehicles may be traveling at a speed of less than 10 MPH, and about 40 to 50 feet of spacing between vehicles may be required. In travel mode, the vehicles may be traveling at speeds of up to around 25 MPH, and about 300 feet to about 500 feet of spacing between vehicles may be required. Depending on the mode in which the vehicles are operating, the CAS may adjust its sensitivity and/or settings in order to better predict when collisions may be imminent.

[00096] For the CAS to operate optimally, each vehicle in a work gang may need to be equipped with a VMM. The VMMs mounted on/in the vehicles and the CTU may only be able to detect vehicles which are outfitted with a VMM. In one embodiment of the present disclosure, the

CAS requires that every vehicle in a work gang be equipped with a VMM. If all vehicles in a work gang are equipped with a VMM, the CAS may be adapted to eliminate false warnings which plague existing systems, such as radar-based systems.

[00097] FIG. 13 depicts a flow diagram 1300 that shows exemplary steps in the operation of a CAS, in accordance with one or more embodiments of the present disclosure. To explain the operation of a particular vehicle / VMM, the immediate vehicle / VMM may be referred to as the "host" and nearby vehicles / VMMs with which the host links / communicates may be referred to as "targets". It should be understood that when the functionality of a host in relation to targets is explained, each target may also act as a host for the purposes of explaining how that target vehicle operates in relation to nearby vehicles.

[00098] Referring to FIG. 13, at step 1302, the host vehicle / VMM is powered up. This may be referred to as the initial start-up. The VMM may begin to operate whenever a vehicle's systems are powered up. At step 1304, within a few seconds of initial startup, the host VMM may begin to automatically detect the existence of other vehicles / VMMs in the vicinity. For example, the host VMM may automatically activate one or more vehicle communication devices to search for / link with other vehicles (targets) both in front of the host vehicle and/or behind the host vehicle. The host may survey its surroundings to determine if there is any other VMM-type equipment nearby. At step 1306, the host may determine which discovered targets, both in front and in back, are the closest and may sense / measure the actual separation distance between the closest target in front and the closest target in the back. In some embodiments, the host may sense and compute distances for vehicles beyond just the vehicles immediately to the front and back of the host. At step 1308, the host VMM may continuously sense / calculate distances between the host vehicle and the target vehicles. In some embodiments, the host may sense and compute distances for vehicles beyond just the vehicles immediately to the front and back of the host.

[00099] At step 1310, the host (and perhaps other target vehicles) may transmit location and speed information to the CTU, for example through the radio antenna. Additionally or alternatively, the host VMM may transmit (and/or receive) location and speed information, for example through one or more vehicle communication devices, to target vehicles / VMMs. At step 1312, the CTU and/or CTU module inside the host VMM may calculate information, for example absolute and relative location of the vehicles in the work gang, speed and direction of vehicles, separation distances and/or safe distance violations. At step 1314, if the CTU and/or host VMM determines that collision is imminent or prescribed safe distances are violated, the host VMM, for example via a user interface, may notify the operator. For example, if the speed and direction information violates preset separation criteria, one or more warning indicators and/or audible

buzzers, alarms and the like will activate. Additionally, the host VMM may communicate the violation to the CTU, perhaps through the radio antenna. At step 1316, if the separation violation has been resolved, for example by the movement of vehicles away from each other, the warning / notification indicator to the operator may silence, and the host may resume monitoring for other potential violations by continuously sensing nearby vehicles and computing separation distances (return to step 1308).

[000100] FIG. 14 depicts a flow diagram 1400 that shows exemplary steps in the operation of a CAS, in accordance with one or more embodiments of the present disclosure. Specifically, flow diagram 1400 shows exemplary steps illustrating how a CAS may determine distances between vehicles. Each vehicle in a work gang may include a GPS unit as well as other sensor technologies such as UWB sensors.

[000101] At step 1402, a host may utilize its GPS unit to determine its absolute location and speed (and perhaps direction of travel). At step 1404, the host may determine that it would benefit from information from other non-GPS type sensors. For example, one or more vehicles in the work gang may become unable to utilize the vehicle's GPS unit. Vehicles may travel through tunnels, mountains and developed areas that include structures that may prevent or reduce the functionality of GPS-based technologies, resulting in the GPS signal being lost (the "dead reckoning" situation). In these types of situations, the host may determine that other types of sensors included in (or in communication with) the VMM may aid in determining the precise location of vehicles. Even if the GPS signal is not lost, these other types of sensors may be used to enhance the precision of the location information gathered with respect to a vehicle. At step 1406, the host may utilize non-GPS sensors to determine relative location and speed information. The host may utilize one or more vehicle communication devices. For example, the UWB unit may determine separation distance and closing speed. The host may utilize components connected to the VMM via component interfaces. For example, a Doppler radar or encoder wheel may determine ground speed and direction of travel.

[000102] At step 1408, the host VMM and/or the CTU may compute separation distances between the host and other vehicles. For example, the microprocessor in the CEM (a component of the VMM) may compute the separation distance between the host and adjacent vehicles. In one illustrative example, a maintenance vehicle (the host) is 40 feet long, and a TSM is installed 10 feet behind the front of the vehicle. Another maintenance vehicle (the target) is also 40 feet long, and a TSM is installed 30 forward from the back of the vehicle. If there is 50 feet between the front of the host vehicle and the rear of the target vehicle, the CAS will measure a distance between the TSMs of 90 feet (10 feet + 50 feet + 30 feet). The CAS may then perform calculations to

compensate for the placement of the TSMs relative to the front and rear of the vehicles. For example, the CAS will subtract 10 feet and 30 feet (the respective distances between the each TSM and the relevant ends of the vehicle) and determine a separation distance of 50 feet (90 feet – 10 feet – 30 feet).

[000103] At step 1410, the host VMM and/or the CTU may compare computed separation distances to prescribed (safe) separation distances for the given vehicle speed / size. At step 1412, the host VMM and/or the CTU may determine whether a collision is imminent and whether an operator must be cautioned. The CAS may consider a variety of types of data and scenarios to determine if a collision is imminent. For example, a separation distance of 40 feet may be acceptable when vehicles are traveling at 5 miles per hour, but if the vehicles are traveling at 20 miles per hour, an unsafe condition may exists and the operator will be notified with an audible and visual alert. In another example, a vehicle that is far ahead may not pose a hazard, but one that is directly ahead, and moving slower than the host vehicle may be a potential collision hazard. In another example, two vehicles may have been creeping along the tracks at a separation distance of 100 feet, and then the vehicles speed up to reach another worksite. If the separation distance does not increase with the increase in speed, the CAS may sound a warning or alarm.

[000104] Using various combinations of technologies (UWB, encoder modules, radar, etc.), the CAS can monitor the precise relative location and speed of the vehicles in a work gang, and determine whether a predetermined separation distance has been violated. The CAS may notify, caution, and/or alarm vehicle operators and/or other railroad personnel (via audible and/or visual indicators) when the separation distances between rail line vehicles becomes less than a specified safe distance, which may indicated that a vehicle is approaching another vehicle and is within a separation distance which may not be safe. The specified safe distance may be programmed by trained service technicians.

[000105] Instead of sounding a "hard" alarm through visual and audible alarms when a separation distance is violated, the CAS may utilize a "progressive" warning approach. In general, as the relative spacing between potential alarm events decreases, the collision avoidance system may increase the severity of the warning indication. For example, if a vehicle is on a collision course but has not yet reached a hard threshold, the collision avoidance system may initiate a "soft" alarm / notification initially, such as a short, quiet, visible-only or subdued alarm. The rate, frequency, prominence and/or severity of the alarm may then increase as the vehicles get closer to the hard alarm threshold (indicating a more critical threat condition).

[000106] The CAS may adjust its thresholds according to the speed of one or more vehicles. This feature may be referred to as an "adaptive threshold" feature. The adaptive threshold feature

may allow for scaling of thresholds of the alarm / notification levels based upon the speed of the immediate vehicle and the relative speed of the immediate vehicle and a vehicle that may collide with the immediate vehicle. For example, when vehicles are traveling to a worksite, at a speed of about 25 miles per hour for example, the expected separation distance may be about 300 to about 500 feet. In a scenario where a vehicle is at a worksite, moving slowly, the expected separation distance may be smaller, for example about 40 to 50 feet. The relative vehicle speed determines how long we have to respond to the issue, and our vehicle speed determines how long the stopping distance will be, which is non-linear.

[000107] The CAS may also include an option, mode or switch whereby an operator or a railroad foreman can temporarily deactivate / silence (for example via a user interface) the separation warning / notification features of one or more vehicles. Once silenced, a warning / notification may not repeat until the vehicle separation has again exceeded prescribed safe distances, or, for example, the warning / notification may sound again after a defined period of time if the separation distance violation has not been improved. This silencing feature may allow for periodic, sanctioned violations of prescribed separation distances without alarms, buzzers and the like becoming a nuisance to the operators. An operator may simply acknowledge that the violation of the separation distance was deliberate and the notification may not repeat, until another violation occurs for example. If the violation is not acknowledged, the notification / alarm may repeat periodically.

[000108] In some situations, for example, a vehicle operator may be asked by his foreman to temporarily violate the prescribed work separation distances, such as when vehicles come together for a meeting. In this situation, vehicles will slowly approach other vehicles and stop close to other vehicles, so that the work gang may be in a tight group. The operators can then dismount and walk a short distance for a meeting. The collision avoidance system may be designed to accommodate this tight-group situation without needlessly activating alarms, annoying railroad personnel and causing nuisance false alarms, for example by detecting very slow-speed approaches. In some examples, a deactivation may require an operator or a foreman to use a key, code, password or the like to gain authorization to deactivate the warning features. This will prevent an accidental or unauthorized deactivation that may lead to an accident where no warning was sounded. In other examples, the collision avoidance system may automatically reactivate the separation warning features after a certain amount of time, or when the vehicles separate a certain distance (or satisfy a certain distance/speed ratio), so that the system remains in an active tracking and warning mode when the vehicles are working or traveling.

[000109] FIG. 15 depicts a flow diagram 1500 that shows exemplary steps in the operation of a CAS, in accordance with one or more embodiments of the present disclosure. Specifically, flow diagram 1500 shows exemplary steps in the operation of a progressive / graduated warning system. In some embodiments, the CAS may utilize a progressive /graduated warning approach that utilizes classes of warnings and/or notifications. The CAS may start by initiating one class of warning, and then escalate to a more severe class of warning if certain distance / speed measurements violate certain thresholds. Separation distances for progressive / graduated thresholds may be based upon vehicle stopping distance test results as explained elsewhere herein. With regard to the following descriptions, it should be understood that a reference to the CAS or the VMM or the CTU performing a calculation, making a determination, generating a warning/alarm, or other events may actually be performed and/or generated by one or more components within the CAS, VMM and/or CTU.

[000110] At step 1502, the CAS system may determine that a certain distance / speed measurements violate one or more certain preliminary thresholds. At step 1504, the CAS generates a first class of warning. In one example, the first class of warning may be labeled as a "notification." In certain situations, it may not be dangerous to violate preliminary thresholds (for example, in the case of work vehicles congregating for a meeting), and thus notifications may be designed to allow operators to ignore / silence them. At step 1506, the CAS may accept input from an operator regarding whether the operator wants to silence the notification. For example, an operator could indicate an "acknowledge" choice via a button, touch screen or the like. At step 1508, if the operator chooses to silence / acknowledge the notification, this may silence the notification once, at least until a violation that leads to a notification reoccurs. Notifications may be auto ignored in certain situations, for example, if vehicles are moving very slowly. Notifications may be less prominent than other classes of warnings. For example, notifications may display on a screen on the user interface, and may initiate a short sound, without being too annoying or distracting to the operator.

[000111] At step 1510, the CAS system may determine that a certain distance / speed measurements violate certain intermediate thresholds, thresholds that the CAS system has determined present a higher risk of collision. At step 1512, the CAS may generate a second class of warning. In one example, the second class of warning may be labeled as a "caution" warning. In certain situations, it may not be dangerous to violate these intermediate thresholds, at least momentarily, and thus notifications may be designed to allow operators to ignore / silence them momentarily. At step 1514, the CAS may accept input from an operator regarding whether the operator wants to silence the caution. At step 1516, silenced caution warnings may reinitiate

quickly if silenced, unless the situation that led to the caution warning is remedied. Caution warnings may be more prominent than notifications but may be less prominent than other more severe classes of warnings. For example, caution warnings may display on a screen on the user interface in a more prominent manner than notifications, such as by blinking, taking up more of the user interface screen, etc. Caution warnings may initiate a louder sound than notifications, but may be designed to avoid being too annoying or distracting to the operator.

[000112] At step 1518, the CAS system may determine that certain distance / speed measurements violate certain critical thresholds, thresholds that the CAS system has determined present a high risk of collision and require immediate correction. At step 1520, the CAS may generate a third class of warning. In one example, the third class of warning may be labeled as an "alarm" warning. In certain situations, it may be dangerous to violate these critical thresholds, and thus alarms may be designed to prevent operators from ignoring / silencing them. Caution warnings may be designed to get the attention of an operator very quickly, for example by being prominent, loud, frequent, bright and the like. For example, alarms may display on a screen on the user interface in a very prominent manner, such as by blinking, taking up the entire user interface screen, etc. Alarms may initiate a loud sound, and may be designed to be annoying and/or attention getting in order to force the operator to take steps to remedy the situation. Once the operator takes steps to remedy the situation, the warnings may scale back from "alarm" to "caution" to "notification" classification and/or may stop completely.

[000113] The progressive / graduated warning system described in relation to FIG. 15 may utilize an "adaptive threshold" feature, whereby one or more thresholds (for example the preliminary, intermediate and critical thresholds) may be modified depending on the speed of one or more vehicles. The adaptive threshold feature may allow for scaling of thresholds of the alarm / notification levels based upon the speed of the immediate vehicle and the relative speed of the immediate vehicle and a vehicle that may collide with the immediate vehicle.

[000114] As explained above, the maintenance vehicles often work in work gangs comprising a plurality of vehicles, for example, a group of between four and forty vehicles, and the collision avoidance system is capable of tracking each vehicle that is part of the work gang. In some embodiments of the present technology, however, a single collision avoidance system may be responsible for tracking vehicles that are part of more than one work gang. For example, the collision avoidance system may track group A and group B. A collision avoidance system may be designed to distinguish between multiple work gangs so that the collision avoidance system can determine which vehicles are on the same track. In the event that maintenance vehicles are on two closely-located parallel tracks, it may be difficult for the collision avoidance system to determine

which vehicles are on the same track and thus present real collision risks. The CAS may be adapted and/or programmed to handle work group designations / associations in order to limit unwanted detections of other maintenance vehicles on adjacent tracks.

[000115] In some embodiments, the VMMs and/or the CTU may include a switch, button, touch screen or the like that may be adapted to allow an operator to select from multiple group associations. All maintenance vehicles on a single track, for example, may set their switch, button, touch screen or the like to select the same group association / setting, and vehicles on a second parallel or other close but separate track may select a different group association / setting. The collision avoidance system may be adapted to ignore (or distinguish) the vehicles on the other tracks (vehicles with an alternate group association / setting), when tracking vehicles within a target group. For example, the work group selections / associations may allow the VMMs / CTU to only notify or alarm an operator when a separation distance violation is detected with other vehicles on the same track / rail. In some embodiments, the CAS may calculate the locations of vehicles using GPS data (or data from other positioning components) and may determine vector locations of such vehicles from which a reasonable calculation of track location can be determined. Other vehicles on an alternate vector could be dismissed by the collision avoidance system when tracking vehicles within a target group.

[000116] In some embodiments of the present disclosure, the CAS may include a stopping distance calibration feature and/or may perform a stopping distance calibration method. The stopping distance calibration feature/method may determine how quickly a rail line vehicle can stop under current conditions. For example, during a maintenance project, the work gang generally performs a stopping distance test (for example, at the beginning of each work day) where a vehicle is run at a speed (for example, 25 miles per hour) and then the vehicle's brakes may be engaged and a distance may be measured from the point where the brakes were engaged to the point where the vehicle comes to a stop. This distance may be referred to as the "stopping distance." If the weather changes and the tracks become wet (or dry), a similar stopping distance test may be performed again, and a new distance measured.

[000117] After the stopping distance is measured, the CAS may calculate various safety metrics based on the stopping distance. For example, a safe following distance between vehicles may be adjusted according to the stopping distance. In some embodiments, the collision avoidance system may maintain minimum/default metrics and then adjust the metrics if necessary based on the stopping distance. For example, a minimum/default following distance may be maintained in all situations, and the following distance may be adjusted upwards (extended) if the stopping distance is relatively high. The stopping distance may be used in conjunction with an adaptive

threshold feature of a progressive / graduated warning system as described above. For example, one or more safe separation distance thresholds (for example preliminary, intermediate and critical thresholds) may be modified depending on the stopping distance. The adaptive threshold feature may allow for scaling of thresholds of the alarm / notification levels based upon the stopping distance. In one example, one or more alarm thresholds may be made more strict if the stopping distance is too high, resulting in earlier alarms, for example to allow sufficient time to stop under the current conditions.

[000118] The CAS may include an automatic / real-time stopping distance calibration feature that, when triggered, may automatically calculate the stopping distance using information from the vehicle mounted module's GPS unit and/or inertial measurement unit (for example an accelerometer or a gyroscope). The new following distance will then be automatically calculated and utilized automatically as the collision avoidance system monitors for proper vehicle separation distance.

[000119] The CAS may create and/or maintain one or more logs of events that occur during the operation of the collision avoidance system. The individual VMMs may log information regarding the vehicle on which the vehicle mounted module is mounted. The CTU may also log information regarding the several vehicles in the work gang that the CTU tracks. Saved logs may be downloadable by an authorized person, for example via a cable or a wireless connection to a laptop computer or via an interface card. The amount of log data and time periods of data may be adjustable. Each log entry may be stamped with various types of information, for example the time and duration of the event occurrence, an ID, speed and location of the vehicle and the nature of the event. The collision avoidance system may also log information from a vehicle mounted module's inertial measurement unit (for example an accelerometer or a gyroscope) and/or other shock and impact sensors mounted on a vehicle to record significant impact data related to an incident. All warnings and alarms may be logged as well. Detailed log information may allow railroad personnel to reconstruct the details of an incident. The CAS may allow for logging of vehicle positioning over time using GPS satellite data. This feature allows long term tracking of vehicle location and activities. The CAS may allow for logging of data related to one or more stopping distance calibration tests, for example routine / daily stopping distance calibration tests and/or automatic / real-time stopping distance calibration tests.

[000120] In some embodiments of the present disclosure, the collision avoidance system may include the ability to monitor worker presence around machines so that a worker or foreman may be alerted if a worker is standing in an unsafe location. For example, if a worker is standing on the tracks near a vehicle as another vehicle approaches and violates a predetermined

separation criteria, the worker and the foreman may be alerted, and perhaps emergency brakes may be activated. The collision avoidance system may monitor the workers by communicating with a communication device that is located on the worker, for example attached to the worker's badge. In one example, the communication device may be an RFID device. In another example, the communication device may be a UWB device, for example a subset of a UWB ranging system that includes components, some that are located on vehicles and some components that are located on workers.

[000121] A communication device located on a worker may communicate with one or more components located in one or more vehicle mounted modules, and/or it may communicate with a central tracking unit in a discrete housing. For example, if the communication device communicates with a vehicle mounted module, the vehicle mounted module may determine the orientation and distance of the worker in relation to the vehicle.

[000122] In some embodiments of the present disclosure, the collision avoidance system may utilize the concepts described herein to monitor the "vehicle stretch" of a train that includes several cars. As a train starts, stops and changes speed, the "play" in the couplings between the cars may allow the total length of the train to change. For example, if the train starts to slow down, the cars may compact closer to each other as the couplings lock more closely, and the overall length of the train may decrease. The opposite may occur if the train begins to accelerate, for example. Vehicle stretch is an important concept because it may be a measure of efficiency in the vehicle. Stretching and compacting of the vehicles wastes energy, and if the stretch of a vehicle can be monitored, the vehicle may be designed to reduce stretch. The collision avoidance system technologies described herein, for example the UWB technology and other close proximity sensing technologies, may be used to monitor distance between train cars, and then calculations can be made in the collision avoidance system to determine vehicle stretch.

[000123] In some embodiments of the present disclosure, the collision avoidance system may monitor, nationwide, locations and speeds of vehicles, equipment and/or workers equipped with collision avoidance system technology. For example, this may allow a central railroad office to monitor several work projects that are underway at several different locations throughout the country.

[000124] In some embodiments of the present disclosure, the collision avoidance system may have the ability to interface with rail line crossing technology to control gates while the vehicles work under the surveillance of the collision avoidance system. For example, if the collision avoidance system and the crossing technology were engineered by the same company, group or firm, the interface may be seamless.

[000125] Regarding the benefits of the collision avoidance system, in addition to the benefits already described in this disclosure, the following describes further benefits of one or more embodiments of the present technology. It is to be understood that the described benefits are not limitations or requirements, and some embodiments may omit one or more of the described benefits. In some embodiments, a benefit of the collision avoidance system may be that it is implemented as a supplement to existing safety procedures and devices already established for railroad maintenance vehicles and personnel. Alternatively, the collision avoidance system may be implemented as a primary (and perhaps the sole) collision avoidance and safety system.

[000126] Other benefits of the collision avoidance system can be realized when the collision avoidance system is compared to a single-sensor collision avoidance technology. Single sensor technologies do not work well when the work environment includes environmental and physical limitations. In addition to the complexities of tracking vehicles that travel through tunnels, mountains, building and the like, tracking vehicles can also become more complex when the vehicles travel or operate around curves or when the vehicles operate at night or during rain, snow and fog. Curves and other weather conditions create complex sensing environments that render single sensor technologies and/or strictly line-of-sight technologies inadequate. The multi-sensor approach of the collision avoidance system described above, allows for precise tracking of vehicles in these situations.

[000127] Another benefit of the collision avoidance system is that railroad companies can use the collision avoidance system to maintain an efficiently running railroad. For example, when an accident occurs in a remote area with single track, it may take days to re-open track after an accident. If the railroad companies can avoid more collisions and keep the tracks open, users of the railroad can make more efficient use of the railroad. A related benefit is that the collision avoidance system can significantly reduce the cost of running a railroad. Not only will the collision avoidance system help the railroad reduce the number of accidents, but the collision avoidance system logging functionality will give the railroads the ability to store data regarding accidents. This information may be used to alleviate rail payouts in the event of worker liability.

[000128] Although the present disclosure describes a collision avoidance system that may be applied to a work gang of railroad vehicles, the technology and the concepts described herein may be utilized in other vehicles, applications and/or industries, for example, in industries where spacing, location and status is important. Some industries that may utilize the concepts described herein are (1) the construction industry, (2) the mining industry, (3) the airport industry, specifically on airport tarmacs.

[000129] In some alterative implementations of the present disclosure, the function or functions illustrated in the blocks or symbols of a block diagram or flowchart may occur out of the order noted in the figures, and/or may include more or less steps than are shown in the figures. For example in some cases two blocks or symbols shown in succession may be executed substantially concurrently or the blocks may sometimes be executed in the reverse order depending upon the functionality involved.

[000130] One or more embodiments of the present disclosure may be realized in hardware, software, or a combination of hardware and software. The present disclosure may be realized in a centralized fashion in at least one machine, computer and/or data processing system; or in a distributed fashion where different elements are spread across several interconnected machines, computers and/or data processing systems. Any kind of machine, computer and/or data processing system or other apparatus adapted for carrying out the methods described herein is suited. A typical combination of hardware and software may be a general-purpose computer system with a computer program that, when being loaded and executed, controls the computer system such that it carries out the methods and techniques described herein.

[000131] Some embodiments of the present disclosure may provide a non-transitory machine and/or computer-readable storage and/or media, having stored thereon, a machine code and/or a computer program having at least one code section executable by a machine, computer and/or data processing system, thereby causing the machine, computer and/or data processing system to perform the steps as described herein. One example of a data processing system is a general purpose computer.

[000132] Some embodiments of the present disclosure may also be embedded in a computer program product, which comprises all the features enabling the implementation of the methods described herein, and which when loaded in a computer system is able to carry out these methods. Computer program in the present context means any expression, in any language, code or notation, of a set of instructions intended to cause a system having an information processing capability to perform a particular function either directly or after either or both of the following: a) conversion to another language, code or notation; b) reproduction in a different material form.

[000133] In the present specification, use of the singular includes the plural except where specifically indicated. In the present specification, any of the functions recited herein may be performed by one or more means for performing such functions. The present systems and methods may include various means, modules, code segments, computer programs and/or software for performing one or more of the steps or actions described in this specification. It is expressly

contemplated and disclosed that the present specification provides a written description for claims comprising such means, modules, steps, code segments, computer programs and/or software.

[000134] The description of the different advantageous embodiments has been presented for purposes of illustration and description and is not intended to be exhaustive or limited to the embodiments in the form disclosed. Many modifications and variations will be apparent to those of ordinary skill in the art. Further different advantageous embodiments may provide different advantages as compared to other advantageous embodiments. The embodiment or embodiments selected are chosen and described in order to best explain the principles of the embodiments the practical application and to enable others of ordinary skill in the art to understand the disclosure for various embodiments with various modifications as are suited to the particular use contemplated.

CLAIMS

1. A rail line vehicle having a vehicle mounted module, the vehicle mounted module comprising

a transponder sensor module including an ultra wideband unit and a wireless communications antenna,

wherein the ultra wideband unit is operable to detect a distance between the rail line vehicle and at least one other vehicle,

wherein the wireless communications antenna is operable to send and receive data over the air;

a control electronics module including a processor that is in communication with at least the ultra wideband unit; and

a user interface module including a user interface,

wherein the user interface is operable to provide a vehicle operator with information and is operable to accept input from the vehicle operator.

2. The rail line vehicle of claim 1 wherein the vehicle mounted module is in communication with one or more central tracking units by way of the wireless communications antenna,

wherein the one or more central tracking units are operable to track the location of the rail line vehicle and at least one other vehicle.

3. The rail line vehicle of claim 1 wherein the vehicle mounted module further comprises a central tracking unit module that is operable to track the location of at least one other vehicle.

4. The rail line vehicle of claim 1 wherein the transponder sensor module further includes a global positioning system,

wherein the global positioning system is operable to receive information from one or more satellites and is operable to determine the absolute position of the rail line vehicle.

5. The rail line vehicle of claim 4 wherein the vehicle mounted module is operable to utilize information generated by the global positioning system and the ultra wideband unit to

determine whether one or more vehicle separation criteria are violated, and

generate a warning if one or more vehicle separation criteria are violated.

6. The rail line vehicle of claim 1 wherein the user interface module further includes a service interface operable to allow the vehicle operator to configure, calibrate, service, maintain, diagnose, update and/or install information on vehicle mounted module.

7. The rail line vehicle of claim 1 wherein the control electronics module further includes one or more interfaces that are operable to communicate with ground speed detection modules.

8. The rail line vehicle of claim 7 wherein the ground speed detection modules include one or more of a microwave radar, a laser device, an infrared sensor and an ultra wideband sensor.

9. The rail line vehicle of claim 1 wherein the control electronics module further includes one or more inertial measurement units.

10. The rail line vehicle of claim 1 wherein the vehicle mounted modules comprises one or more additional transponder sensor modules,

wherein the vehicle mounted module is operable to accept calibration information regarding the length of the rail line vehicle and the mounting locations of the transponder sensor module and the one or more additional transponder sensor modules.

11. The rail line vehicle of claim 1 wherein the vehicle mounted modules comprises an additional ultra wideband unit, wherein an offset exists between the ultra wideband unit and the additional ultra wideband unit once the two units are mounted on the rail line vehicle.

12. The rail line vehicle of claim 1 wherein the ultra wideband unit is adapted to transmit and receive signals with varying center frequencies.

13. The rail line vehicle of claim 1 wherein the transponder sensor module further includes one or more of a laser device, a radar sensor and an infrared sensor.

14. The rail line vehicle of claim 1 wherein the user interface is a touchscreen including a screen, the touchscreen being operable to

display one or more screens, menus, options and/or functions, and

accept user input from the vehicle operator by allowing the vehicle operator to touch the screen of the touchscreen.

15. The rail line vehicle of claim 1 wherein the vehicle mounted module is operable to utilize a progressive warning feature that generates a warning if one or more vehicle separation thresholds are violated,

wherein the rate, frequency, prominence and/or severity of the warning increases as the violation of the vehicle separation threshold becomes more critical.

16. The rail line vehicle of claim 15 wherein the progressive warning feature utilizes an adaptive threshold feature that modifies the one or more vehicle separation thresholds based on the speed of the rail line vehicle and the speed of one or more nearby vehicles.

17. The rail line vehicle of claim 1 wherein the vehicle mounted module is operable to utilize a stopping distance calibration feature that measures a stopping distance,

wherein the stopping distance indicates how quickly the rail line vehicle can stop under current conditions.

18. The rail line vehicle of claim 17 wherein the measured stopping distance is used to modify one or more safe separation distance thresholds.

19. The rail line vehicle of claim 1 wherein the control electronics module further includes an inertial measurement unit.

20. A collision avoidance system comprising:

one or more vehicle mounted modules, each mounted on a vehicle,

each vehicle mounted module comprising:

a transponder sensor module including an ultra wideband unit and a wireless communications antenna,

wherein the ultra wideband unit is operable to detect a distance between the vehicle on which the vehicle mounted module is mounted and at least one other vehicle,

wherein the wireless communications antenna is operable to send and receive data over the air;

a control electronics module including a processor that is in communication with at least the ultra wideband unit; and

a user interface module including a user interface,

wherein the user interface is operable to provide a vehicle operator with information and is operable to accept input from the vehicle operator; and

a central tracking unit that is in communication with the one or more vehicle mounted modules, the central tracking unit being operable to track the location of the one or more vehicle mounted modules.

21. The collision avoidance system of claim 20 wherein the central tracking unit is distributed among the one or more vehicle mounted modules, wherein

each of the one or more vehicle mounted modules includes a central tracking unit component,

each central tracking unit component is in communication with the vehicle's control electronics module.

22. The collision avoidance system of claim 20 wherein the central tracking unit is disposed in a discrete housing.

23. The collision avoidance system of claim 20 wherein the transponder sensor module further includes a global positioning system,

wherein the global positioning system is operable to receive information from one or more satellites and is operable to determine the absolute position of the vehicle mounted module.

24. The collision avoidance system of claim 20 wherein each vehicle mounted module is operable to utilize information generated by the global positioning system, the ultra wideband unit and the central tracking unit to

determine whether one or more vehicle separation criteria are violated, and

generate a warning if one or more vehicle separation criteria are violated.

ABSTRACT

A collision avoidance system (CAS) is described that includes one or more sensor technologies, including, for example, an Ultra Wideband (UWB) sensing technology. The collision avoidance system is designed to reliably track the location and speed of vehicles and the distance between vehicles over a wide variety of track and terrain. The collision avoidance system may utilize information from a variety of sensor technologies to determine whether one or more vehicles violate speed and/or separation criteria, and may generate a warning.

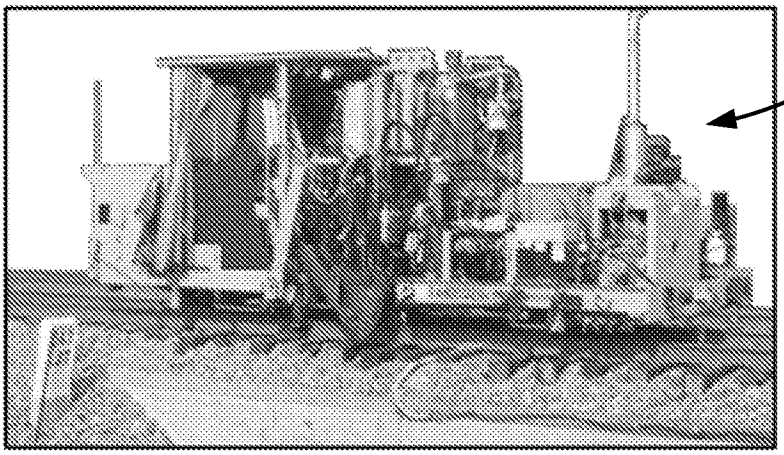


Fig. 1A

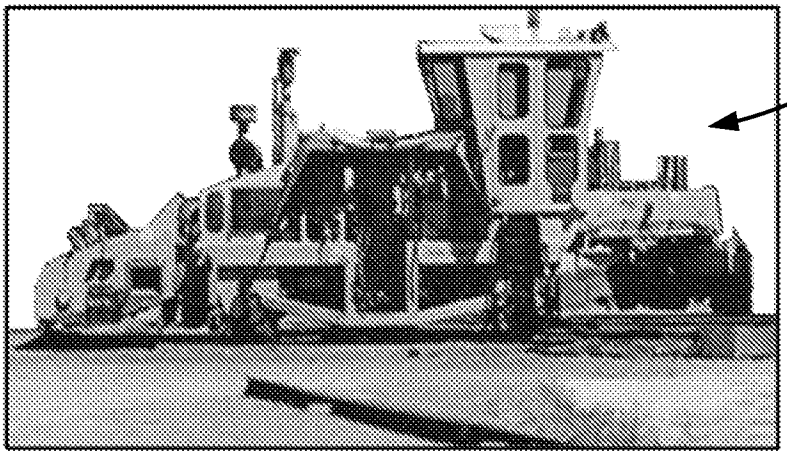


Fig. 1B

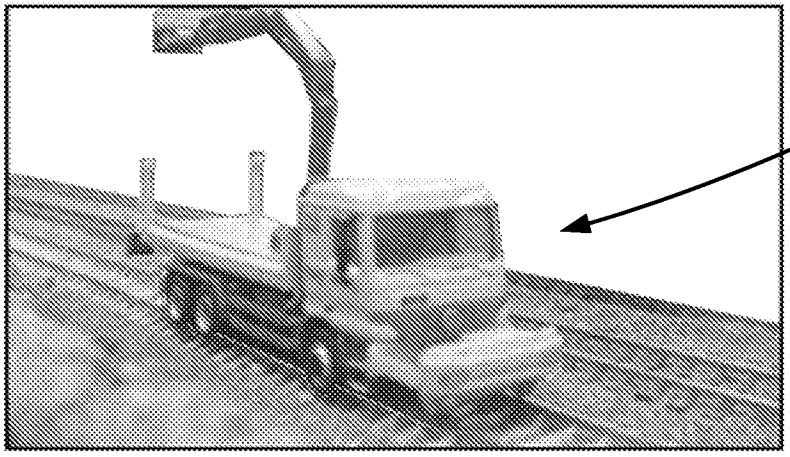
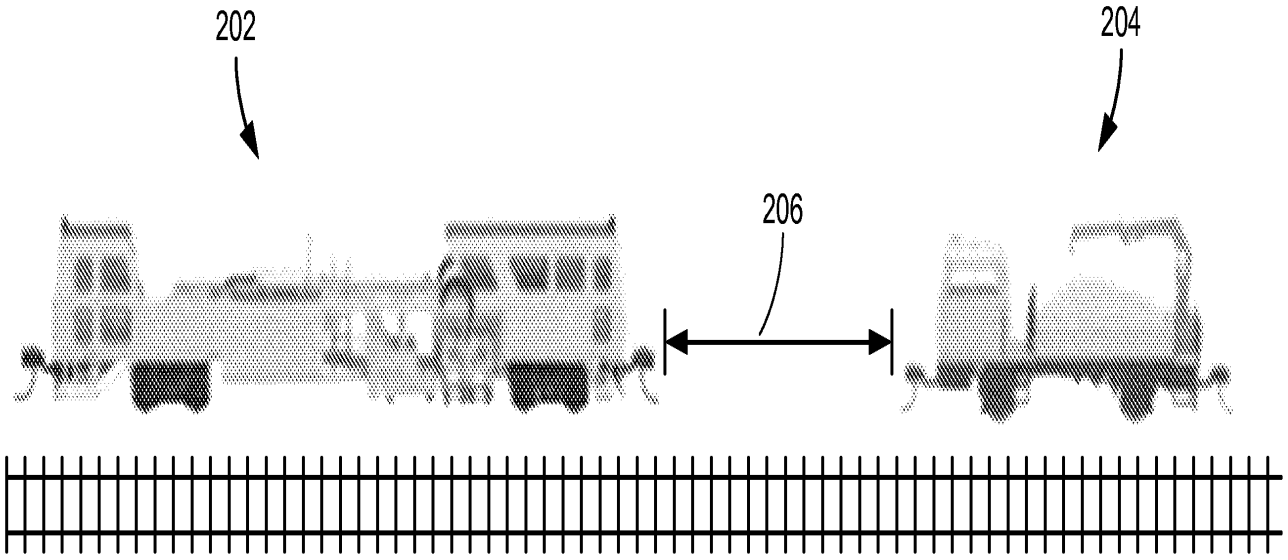


Fig. 1C

Fig. 2



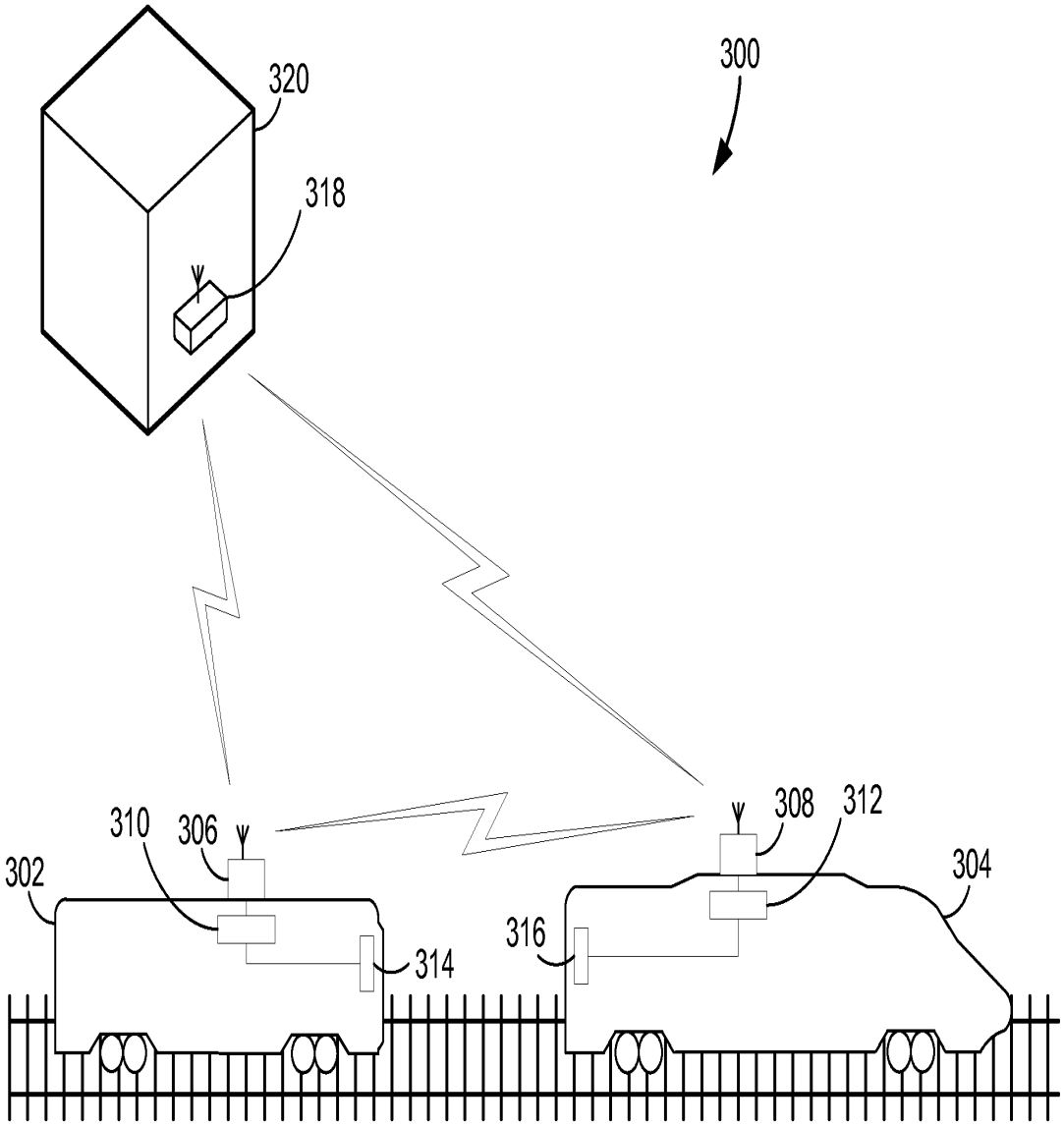


Fig. 3

Fig. 4

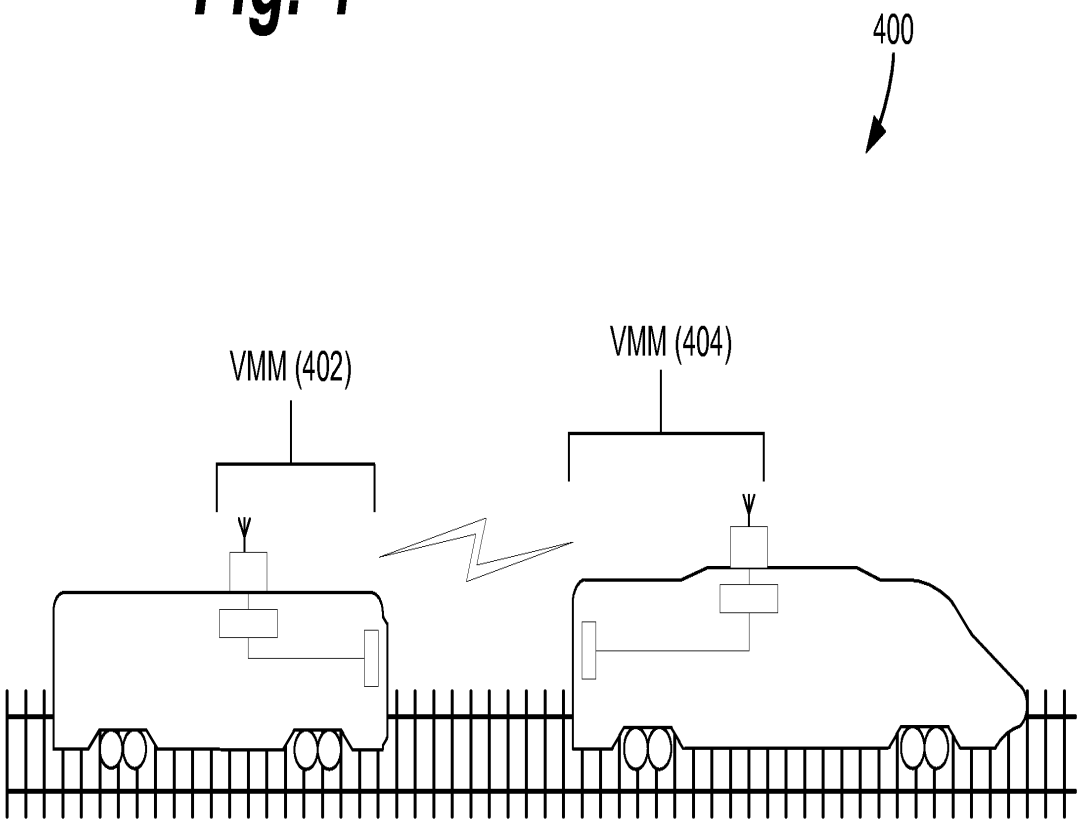
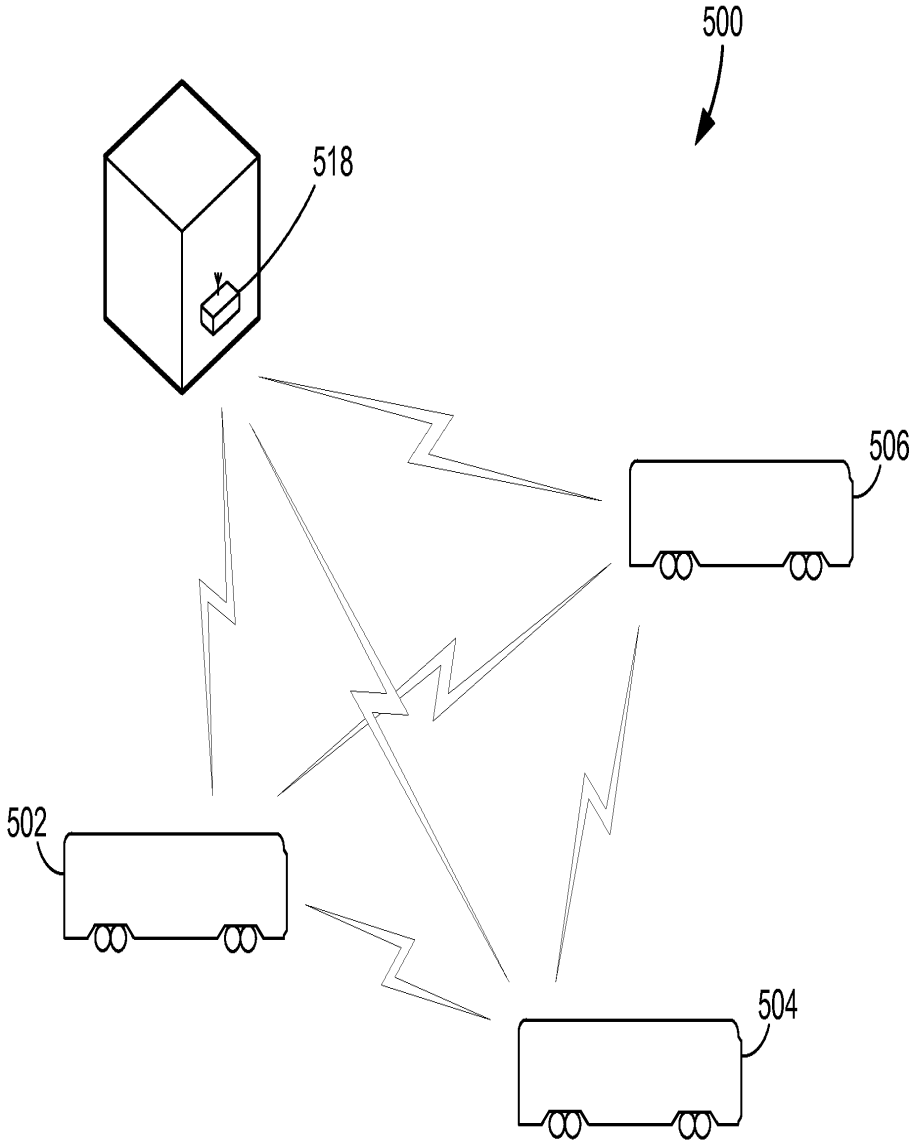


Fig. 5



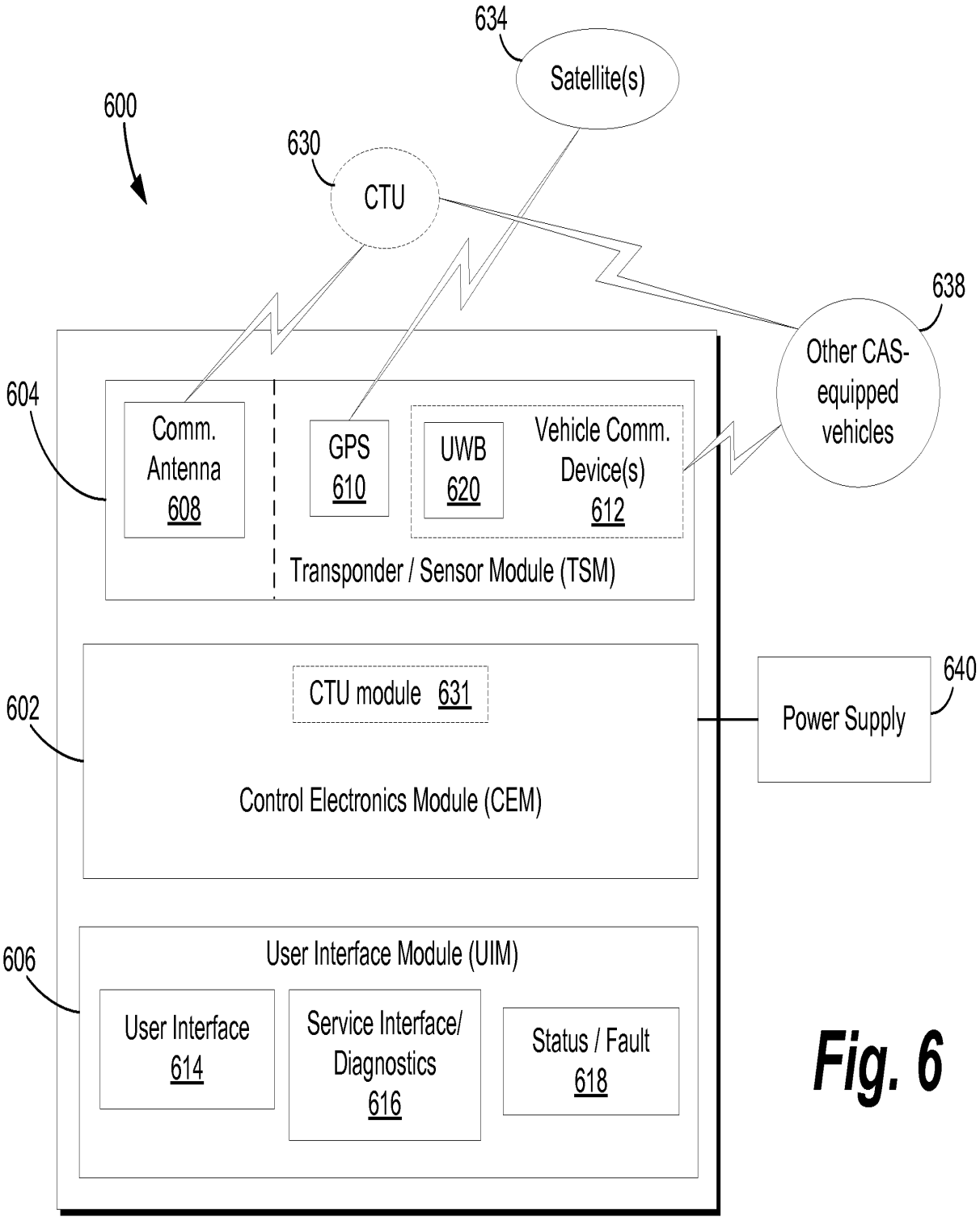
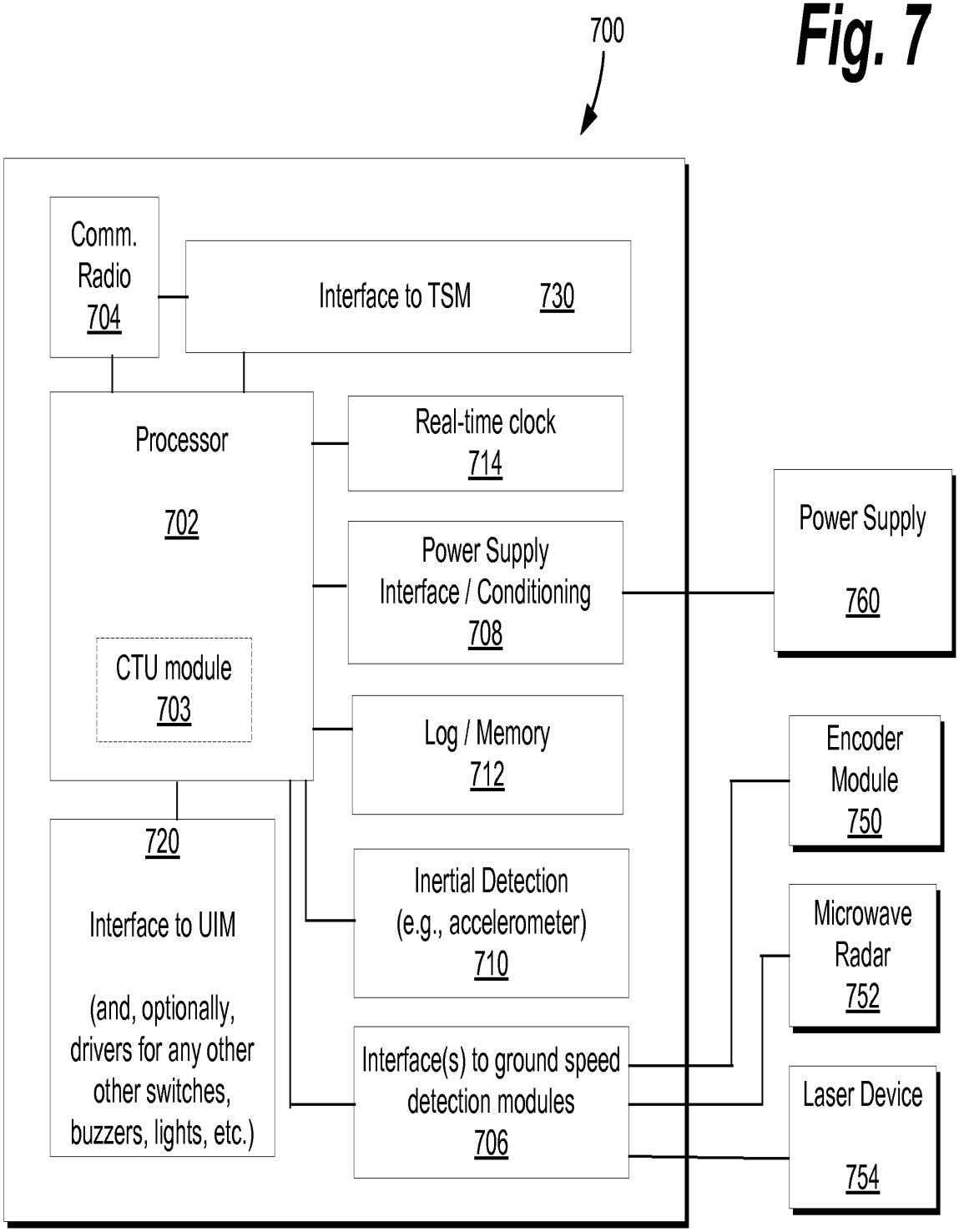

634
Satellite(s)
600
630
CTU
638
Other CAS-equipped vehicles
604
Comm. Antenna 608
GPS 610
UWB 620
Vehicle Comm. Device(s) 612
Transponder / Sensor Module (TSM)
602
CTU module 631
Control Electronics Module (CEM)
640
Power Supply
606
User Interface Module (UIM)
User Interface 614
Service Interface/ Diagnostics 616
Status / Fault 618

Fig. 6

Fig. 7


700
Comm. Radio 704
Interface to TSM 730
Processor 702
Real-time clock 714
Power Supply Interface / Conditioning 708
Power Supply 760
CTU module 703
Log / Memory 712
Encoder Module 750
720
Interface to UIM
(and, optionally, drivers for any other other switches, buzzers, lights, etc.)
Inertial Detection (e.g., accelerometer) 710
Microwave Radar 752
Interface(s) to ground speed detection modules 706
Laser Device 754

7/15

Fig. 8

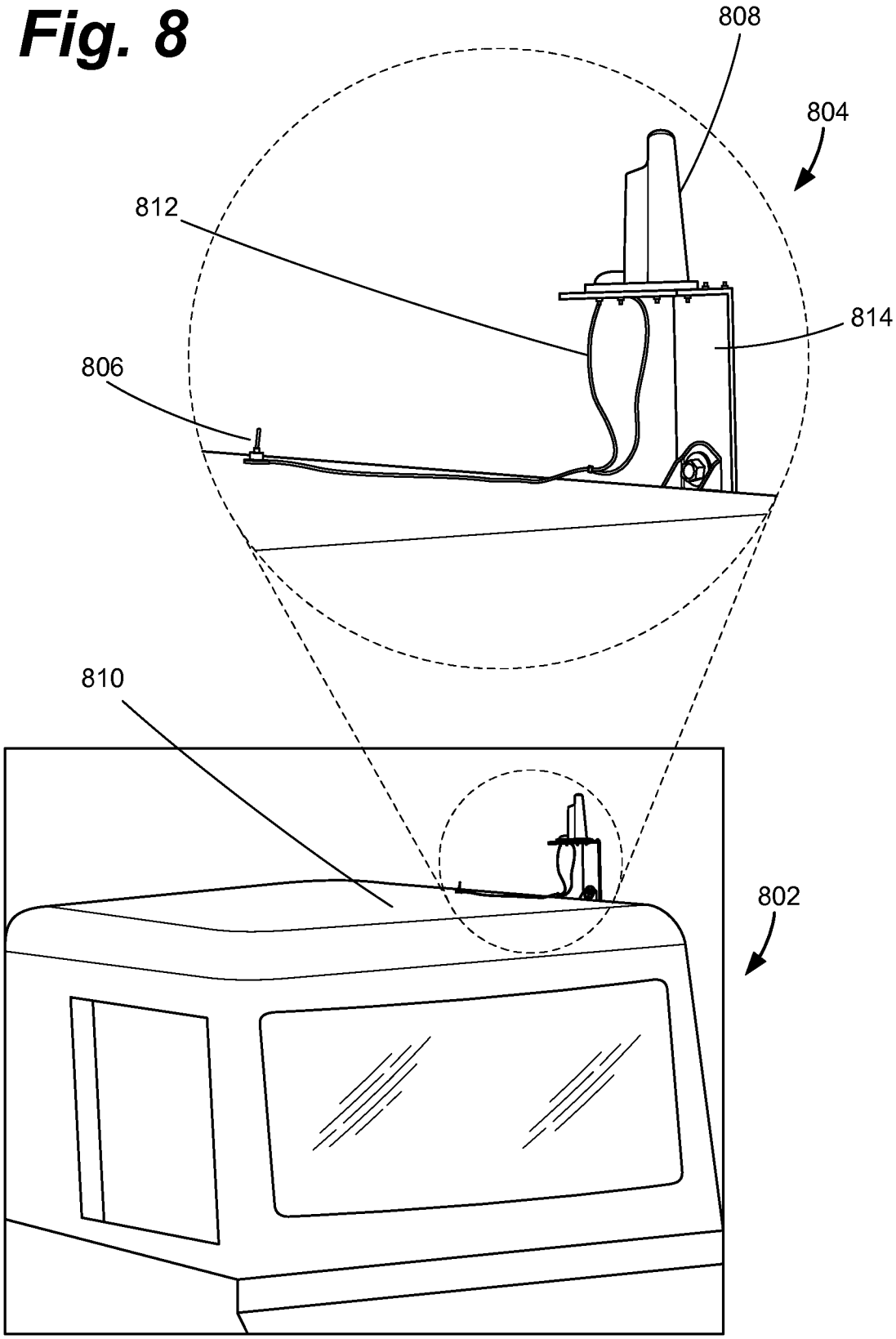
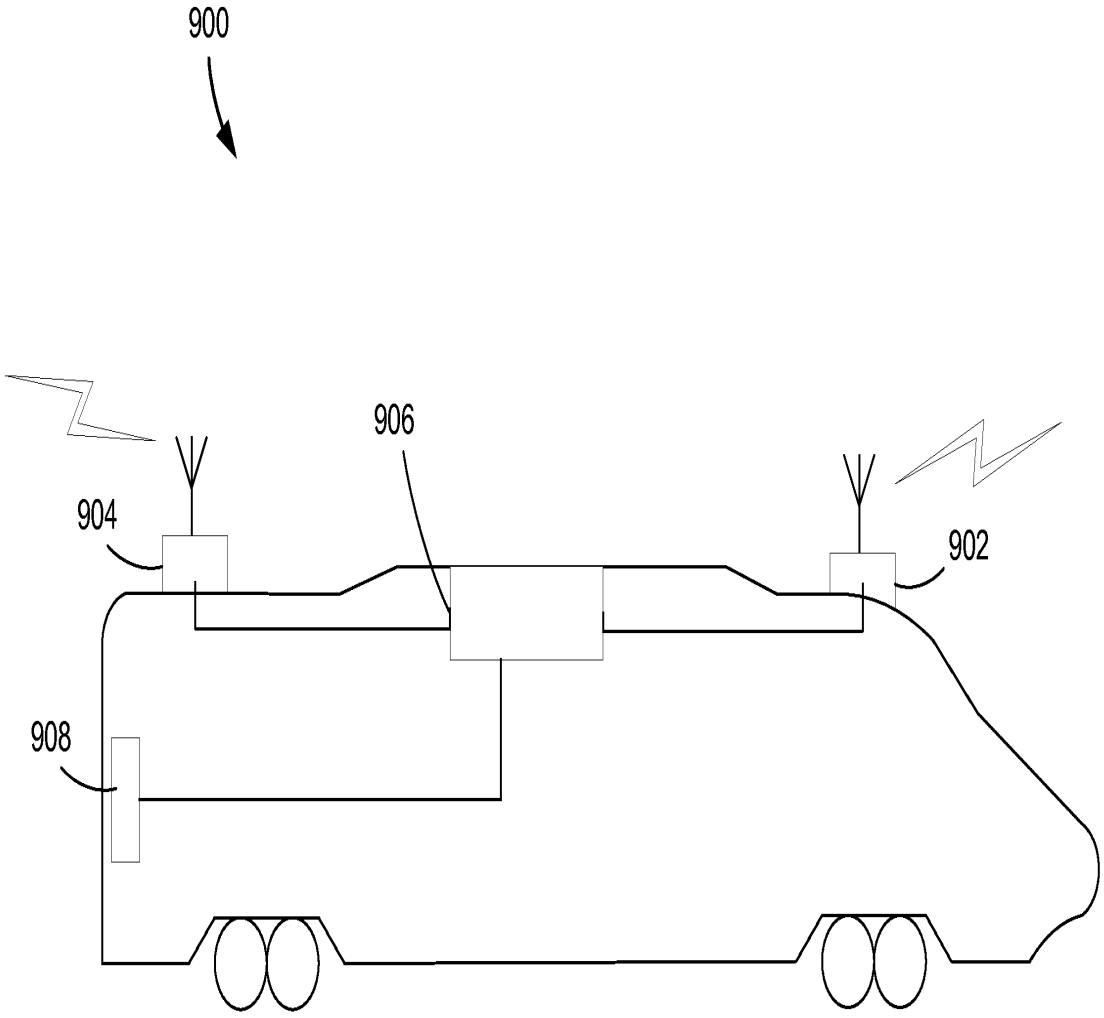


Fig. 9



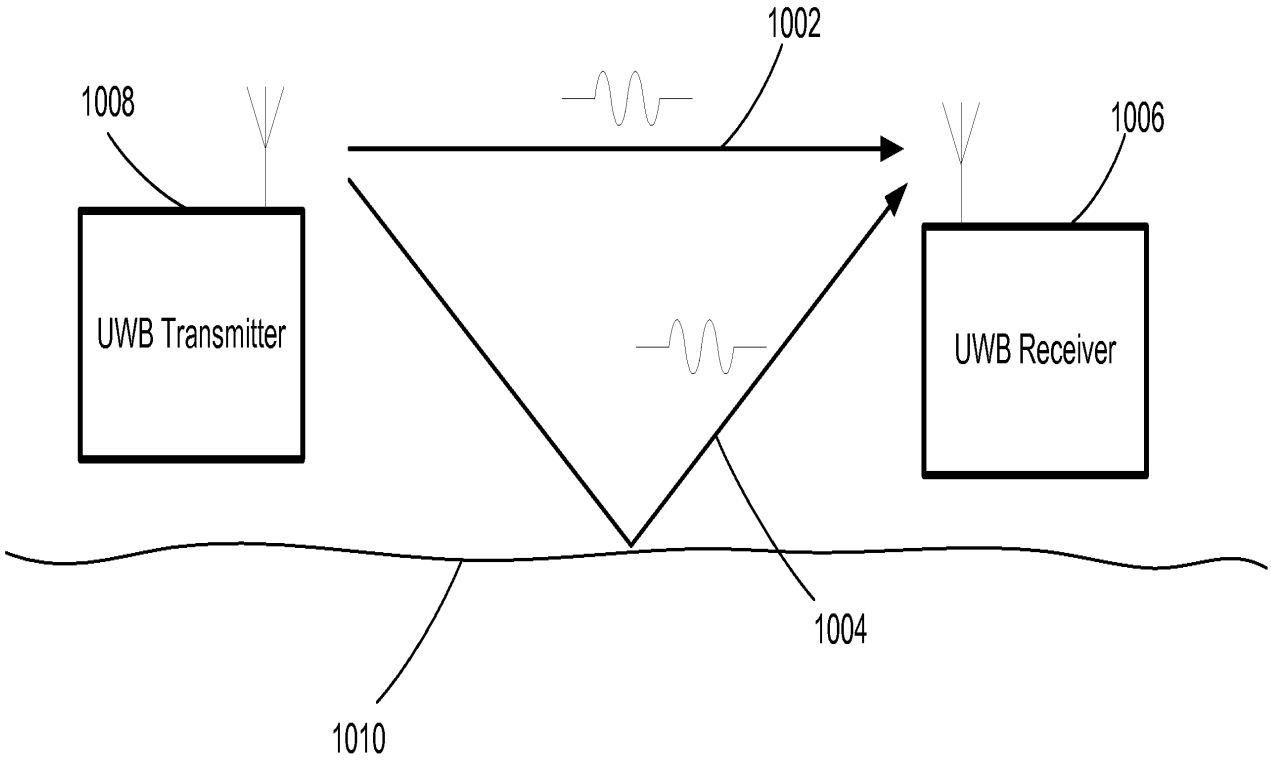


Fig. 10

Fig. 11

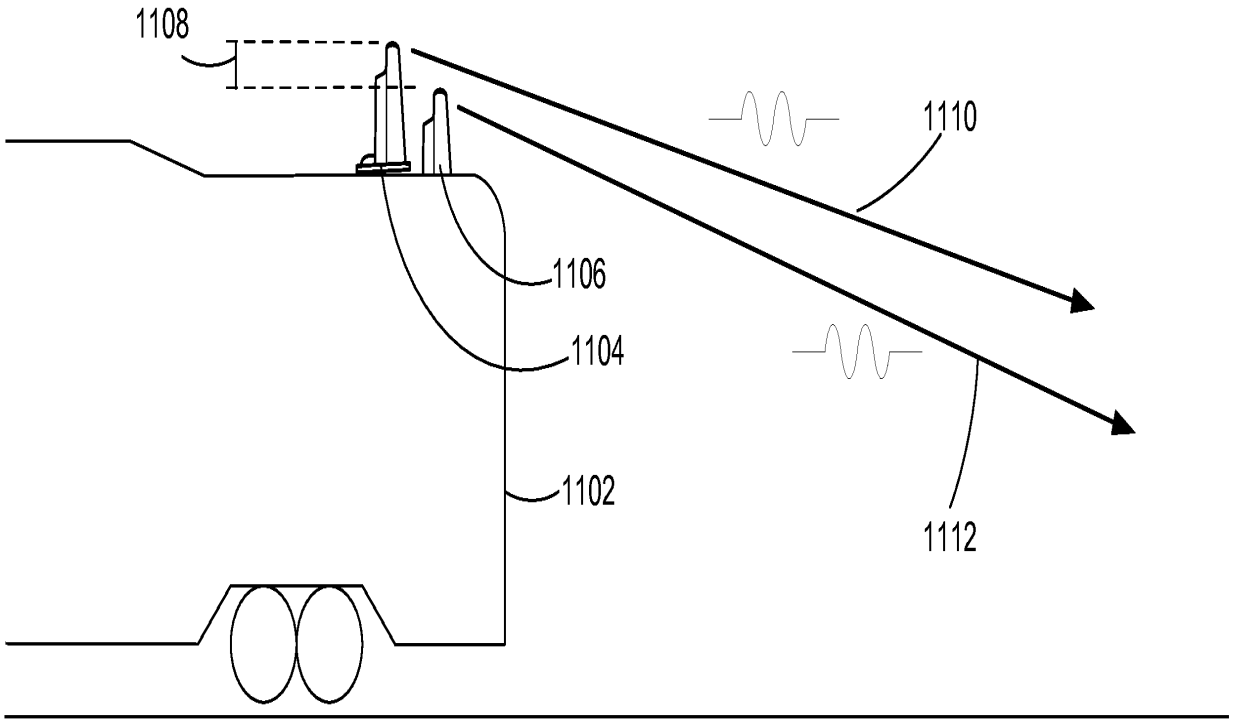


Fig. 12A

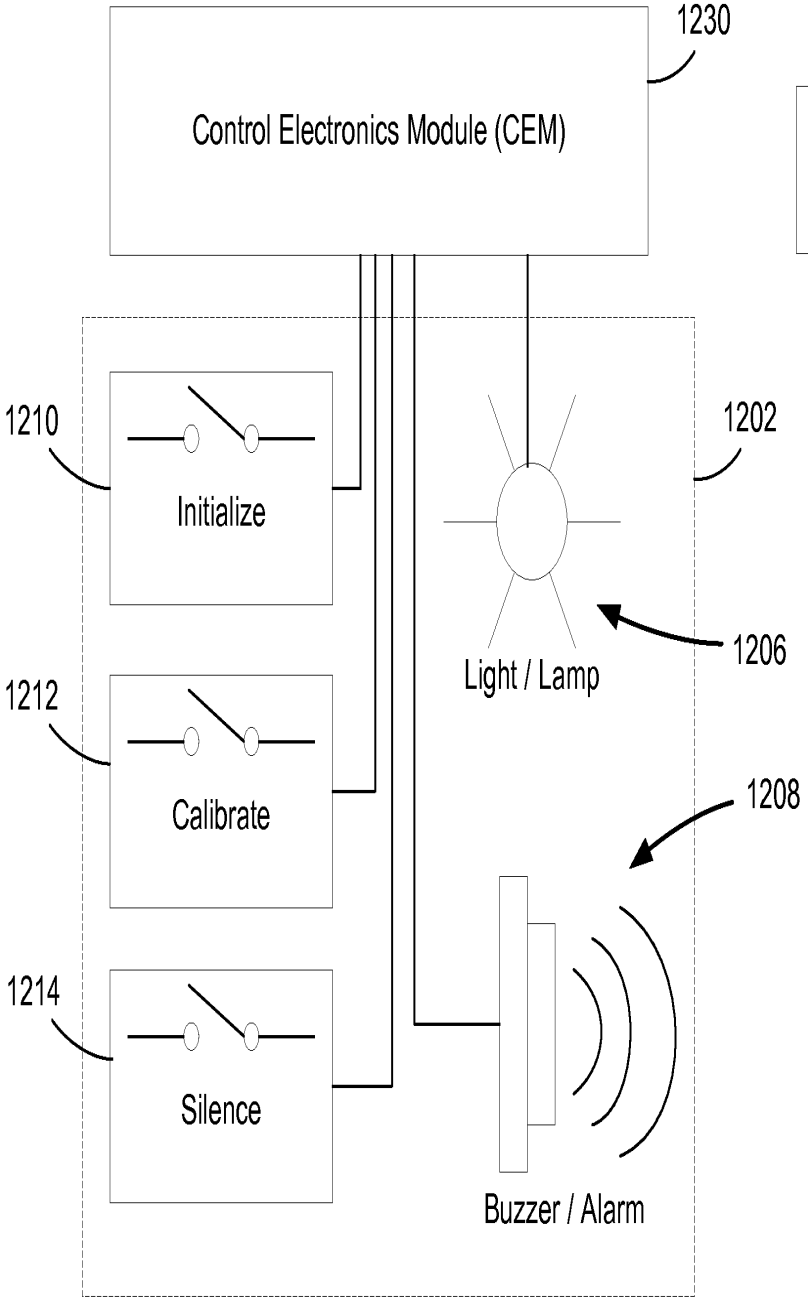
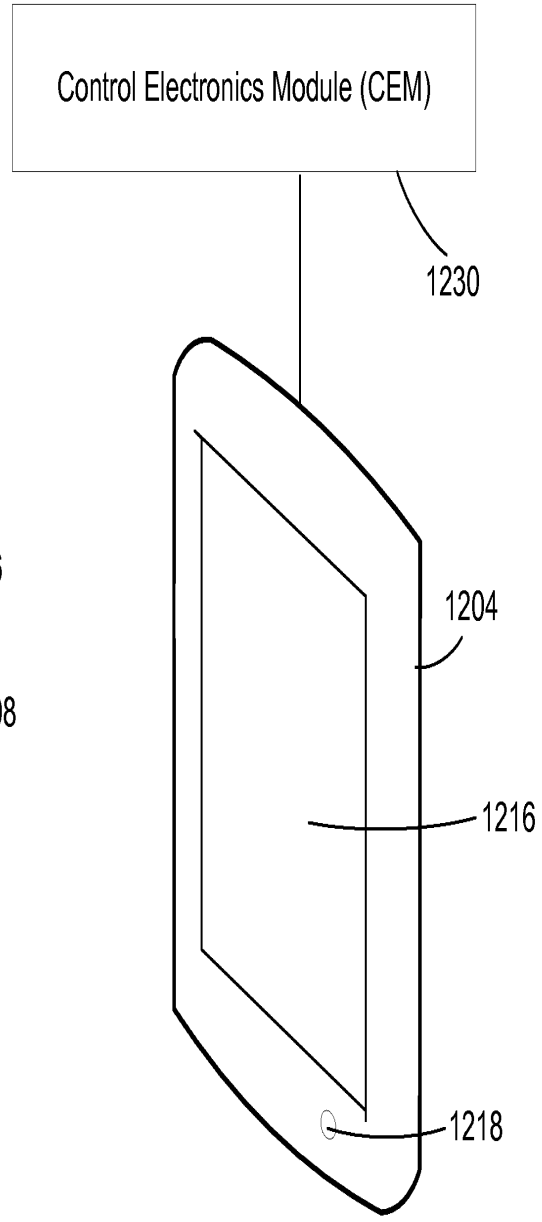
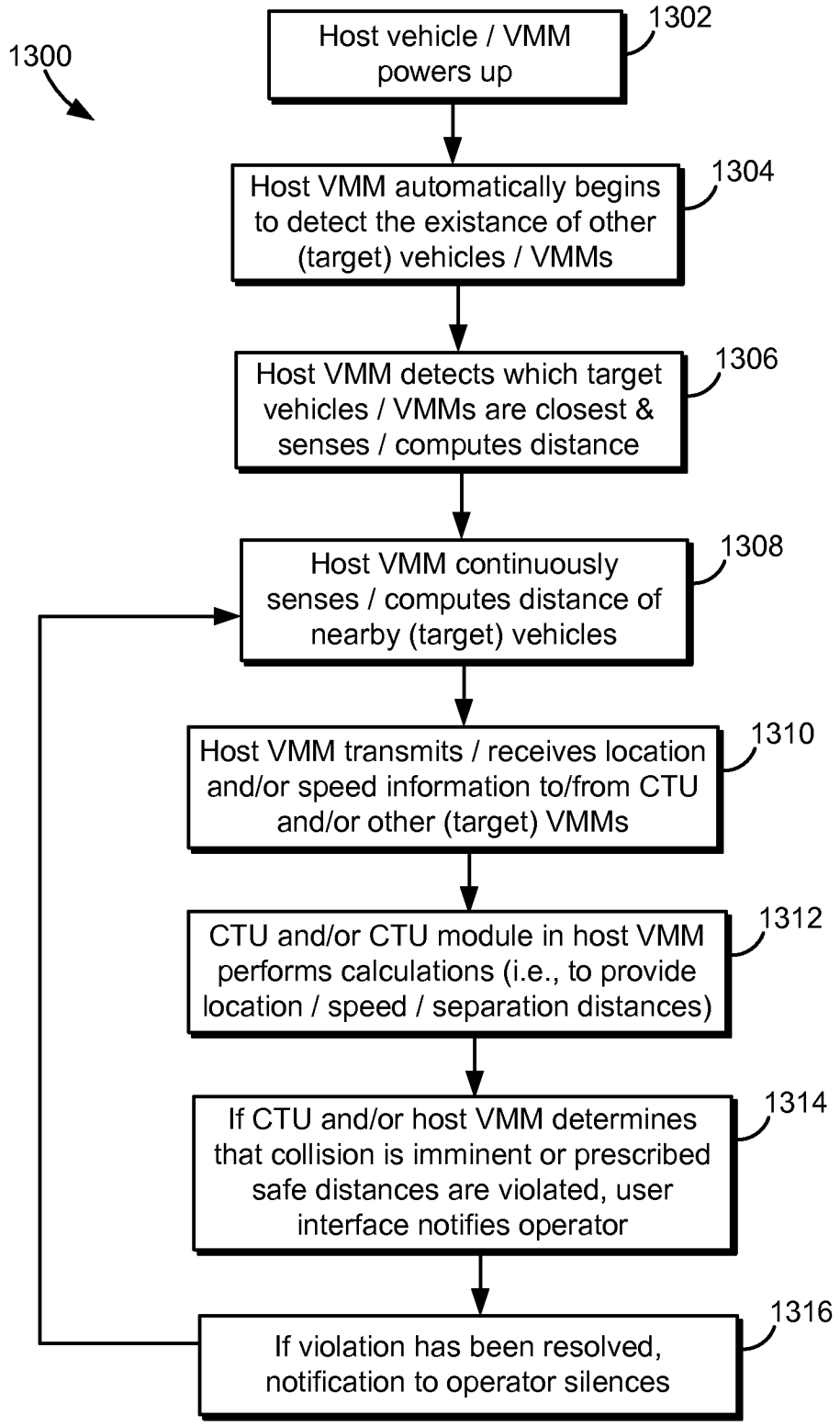
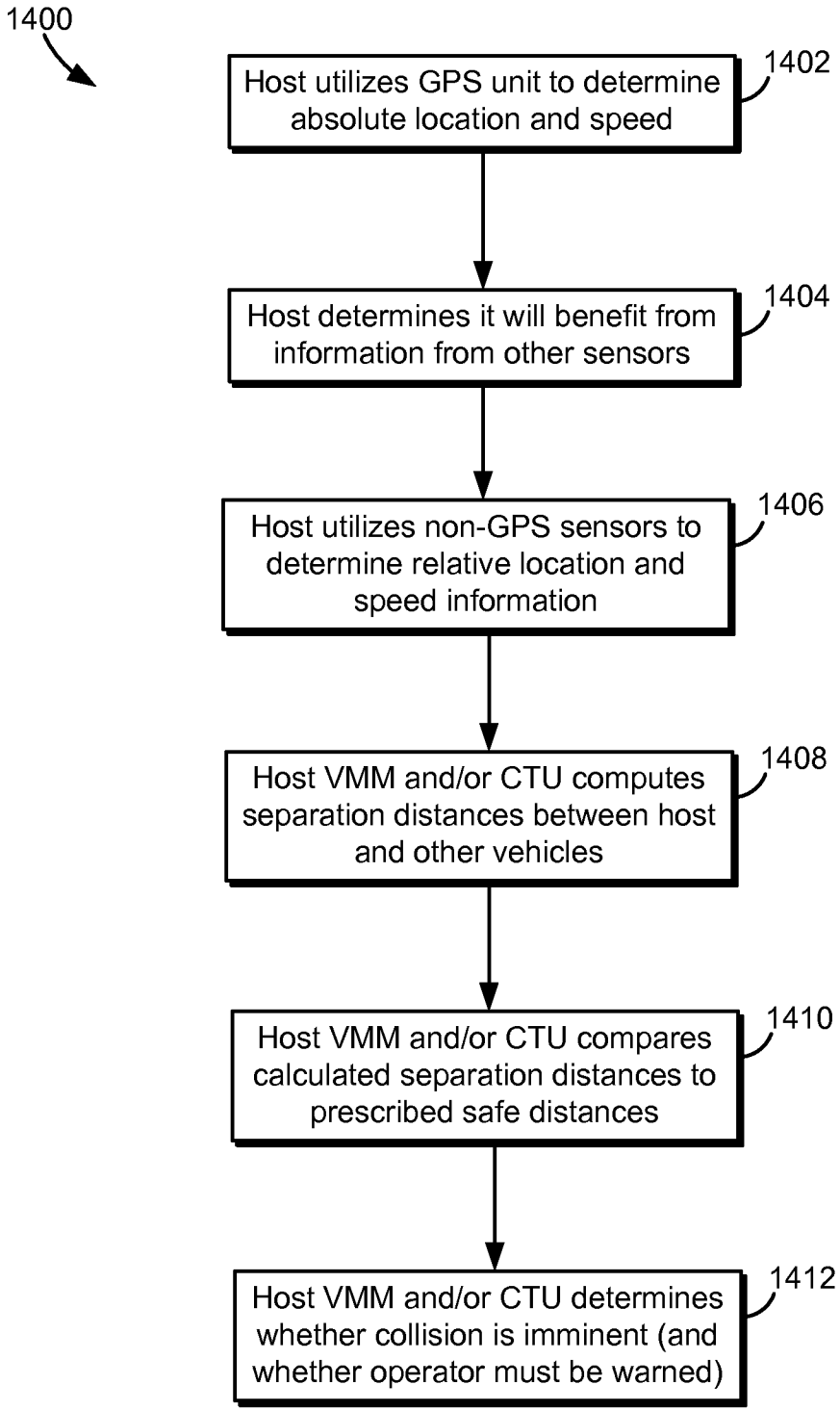
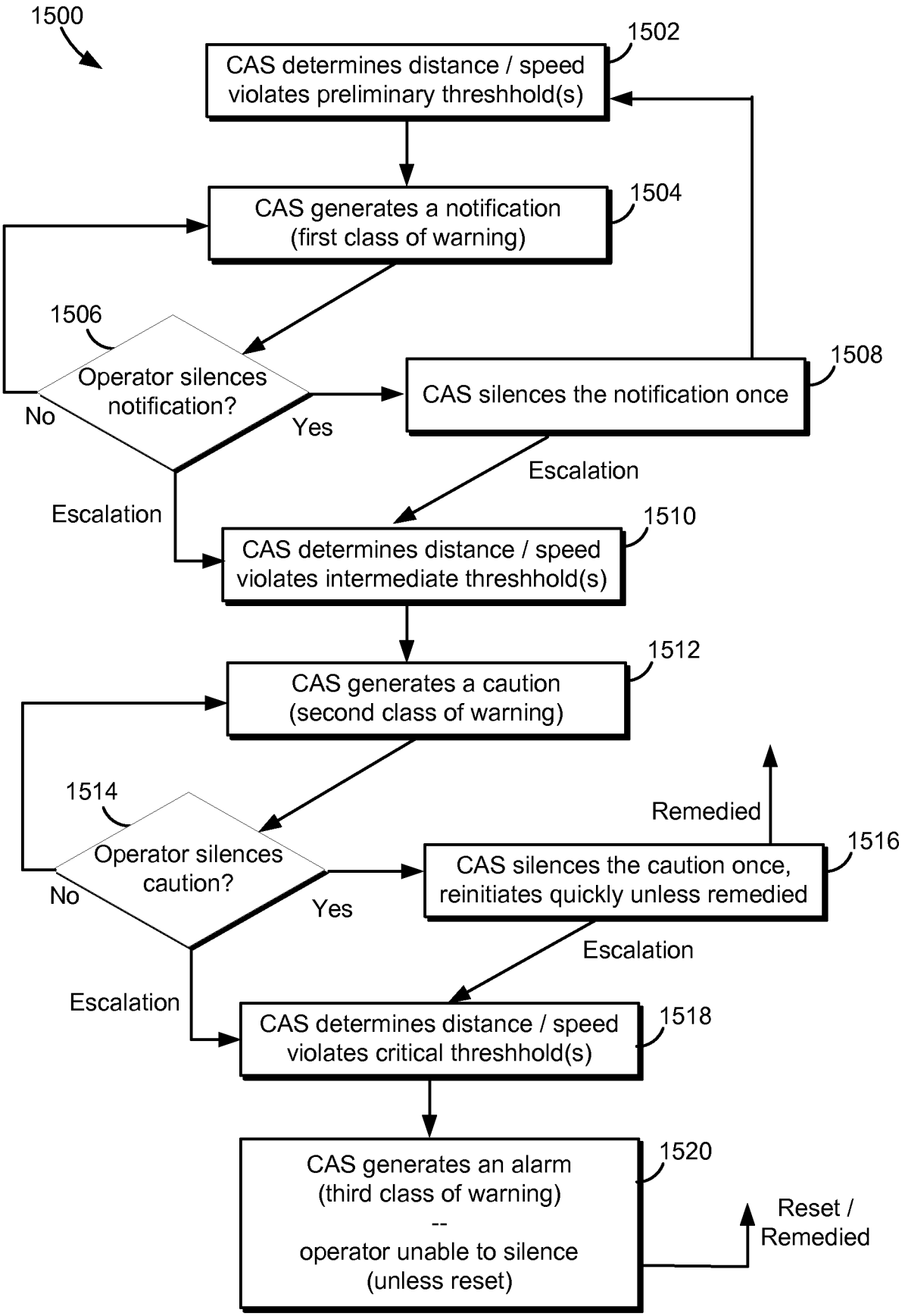


Fig. 12B




1300
Host vehicle / VMM powers up
1302
Host VMM automatically begins to detect the existance of other (target) vehicles / VMMs
1304
Host VMM detects which target vehicles / VMMs are closest & senses / computes distance
1306
Host VMM continuously senses / computes distance of nearby (target) vehicles
1308
Host VMM transmits / receives location and/or speed information to/from CTU and/or other (target) VMMs
1310
CTU and/or CTU module in host VMM performs calculations (i.e., to provide location / speed / separation distances)
1312
If CTU and/or host VMM determines that collision is imminent or prescribed safe distances are violated, user interface notifies operator
1314
If violation has been resolved, notification to operator silences
1316


1400
Host utilizes GPS unit to determine absolute location and speed
1402
Host determines it will benefit from information from other sensors
1404
Host utilizes non-GPS sensors to determine relative location and speed information
1406
Host VMM and/or CTU computes separation distances between host and other vehicles
1408
Host VMM and/or CTU compares calculated separation distances to prescribed safe distances
1410
Host VMM and/or CTU determines whether collision is imminent (and whether operator must be warned)
1412


1500
1502
CAS determines distance / speed violates preliminary threshhold(s)
1504
CAS generates a notification (first class of warning)
1506
Operator silences notification?
No
Yes
1508
CAS silences the notification once
Escalation
Escalation
1510
CAS determines distance / speed violates intermediate threshhold(s)
1512
CAS generates a caution (second class of warning)
1514
Operator silences caution?
No
Yes
Remedied
1516
CAS silences the caution once, reinitiates quickly unless remedied
Escalation
Escalation
1518
CAS determines distance / speed violates critical threshhold(s)
1520
CAS generates an alarm (third class of warning) -- operator unable to silence (unless reset)
Reset / Remedied

PTO/SB/01A (01-09)
Approved for use through 01/31/2014. OMB 0651-0032
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DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	COLLISION AVOIDANCE SYSTEM FOR RAIL LINE VEHICLES

As the below named inventor(s), I/we declare that:

This declaration is directed to:

- [x] The attached application, or
- [ ] United States application or PCT international application number _____ filed on _____
  - [ ] As amended on _____ (if applicable):

I/we believe that I/we am/are the original and first inventor(s) of the subject matter which is claimed and for which a patent is sought;

I/we have reviewed and understand the contents of the above-identified application, including the claims, as amended by any amendment specifically referred to above;

I/we acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me/us to be material to patentability as defined in 37 CFR 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the national or PCT International filing date of the continuation-in-part application.

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All statements made herein of my/our own knowledge are true, all statements made herein on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001, and may jeopardize the validity of the application or any patent issuing thereon.

FULL NAME OF INVENTOR(S)

Inventor one: Richard C. Carlson Date: 5-17-12

Signature: _____ Citizen of: US

Inventor two: Kurt A. Gunther Date: 5-17-2012

Signature: _____ Citizen of: US

- [ ] Additional inventors or a legal representative are being named on _____ additional form(s) attached hereto.

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

FULL NAME OF INVENTOR(S)

Inventor three: Marc W. Cygnus Date: 5-17-12

Signature: Marc W. Cygnus Citizen of: US

SCORE Placeholder Sheet for IFW Content

Application Number: 13474428 Document Date: 5/17/2012

The presence of this form in the IFW record indicates that the following document type was received in electronic format on the date identified above. This content is stored in the SCORE database.

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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
13/474,428	05/17/2012	3617	650	24983US02	24	2

CONFIRMATION NO. 6724

23446
MCANDREWS HELD & MALLOY, LTD
500 WEST MADISON STREET
SUITE 3400
CHICAGO, IL 60661

FILING RECEIPT

OC000000054535576

Date Mailed: 06/01/2012

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Applicant(s)

Richard C. Carlson, Wauconda, IL;
Kurt A. Gunther, Round Lake Heights, IL;
Marc W. Cygnus, Mundelein, IL;

Power of Attorney: The patent practitioners associated with Customer Number 23446

Domestic Priority data as claimed by applicant

This appln claims benefit of 61/598,750 02/14/2012
and claims benefit of 61/627,697 10/17/2011
and claims benefit of 61/519,201 05/19/2011

Foreign Applications (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.)

If Required, Foreign Filing License Granted: 05/29/2012

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 13/474,428**

Projected Publication Date: To Be Determined - pending completion of Corrected Papers

Non-Publication Request: No

Early Publication Request: No
** **SMALL ENTITY** **

Title

COLLISION AVOIDANCE SYSTEM FOR RAIL LINE VEHICLES

Preliminary Class

104

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Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

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Title 37, Code of Federal Regulations, 5.11 & 5.15

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PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 13/474,428

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	95		N/A	
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	310		N/A	
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	125		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	24 minus 20 =	* 4	x 30 =	120	OR		
INDEPENDENT CLAIMS (37 CFR 1.16(h))	2 minus 3 =	*	x 125 =	0.00			
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			0.00			
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				0.00			
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	650		TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT A	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE($)	ADDITIONAL FEE($)		RATE($)	ADDITIONAL FEE($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
13/474,428	05/17/2012	Richard C. Carlson	24983US02

CONFIRMATION NO. 6724

23446
MCANDREWS HELD & MALLOY, LTD
500 WEST MADISON STREET
SUITE 3400
CHICAGO, IL 60661

FORMALITIES LETTER

OC000000054535577

Date Mailed: 06/01/2012

NOTICE TO FILE CORRECTED APPLICATION PAPERS

Filing Date Granted

An application number and filing date have been accorded to this application. The application is informal since it does not comply with the regulations for the reason(s) indicated below. Applicant is given TWO MONTHS from the date of this Notice within which to correct the informalities indicated below. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

The required item(s) identified below must be timely submitted to avoid abandonment:

- Replacement drawings in compliance with 37 CFR 1.84 and 37 CFR 1.121(d) are required. The drawings submitted are not acceptable because:
  - More than one figure is present and each figure is not labeled "Fig." with a consecutive Arabic numeral (1, 2, etc.) or an Arabic numeral and capital letter in the English alphabet (A, B, etc.)(see 37 CFR 1.84(u)(1)). See Figure(s) 13,14,15. A brief description of the several views of the drawings (see 37 CFR 1.74) should be added or amended to correspond to the corrected numbering of the figures. See also 37 CFR 1.77(b)(7).

Applicant is cautioned that correction of the above items may cause the specification and drawings page count to exceed 100 pages. If the specification and drawings exceed 100 pages, applicant will need to submit the required application size fee.

Replies should be mailed to:

Mail Stop Missing Parts
Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

Registered users of EFS-Web may alternatively submit their reply to this notice via EFS-Web.
https://sportal.uspto.gov/authenticate/AuthenticateUserLocalEPF.html

For more information about EFS-Web please call the USPTO Electronic Business Center at **1-866-217-9197** or visit our website at http://www.uspto.gov/ebc.

If you are not using EFS-Web to submit your reply, you must include a copy of this notice.

/tnegash/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
(Our Case No. 24983US02)

In The Application Of:		)
		)
Richard C. Carlson		)
		)
Serial No.:	13/474,428	)
		)
Filed:	May 17, 2012	)
		)
For:	COLLISION AVOIDANCE SYSTEM FOR RAIL LINE VEHICLES	)
		)
Examiner:	Not Assigned	)
		)
Group Art Unit:	Not Assigned	)
		)
Confirmation No.:	6724	)
		)
Customer No.	23446	)

CERTIFICATE OF TRANSMISSION

I hereby certify that this correspondence is being transmitted via EFS-Web to the United States Patent and Trademark Office on June 11, 2012.

By: / Jeb A. Shookman /
Jeb A. Shookman
Reg. No.: 67.793

RESPONSE TO NOTICE TO FILE CORRECTED APPLICATION PAPERS

Mail Stop Missing Parts
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

In response to the Notice to File Corrected Application Papers, dated June 1, 2012, enclosed are the REPLACEMENT SHEET(s) of drawings to be substituted for Figures 1-15, which were originally filed with the above-identified application. In the REPLACEMENT SHEET(s) Figures 1-15, have been revised so that they are in compliance with 37 CFR 1.84 and 37 CFR 1.121(d) as required. The REPLACEMENT SHEET(s) are properly labeled with a consecutive Arabic numeral, i.e. Fig. 13, Fig. 14

and Fig. 15. Also the brief description of the several views of the drawings as required by 37 CFR 1.74 is correct as submitted in the application papers on May 17, 2012.

The Commissioner is hereby authorized to charge any additional fees required in the Application, or to refund any overpayment, to the Deposit Account of McAndrews, Held & Malloy, Ltd., Account No. 13-0017.

Respectfully submitted,

Dated: June 11, 2012

/Jeb A. Shookman/
Jeb A. Shookman
Reg. No. 67,793

McAndrews, Held & Malloy, Ltd.
500 West Madison St., 34th Floor
Chicago, IL 60661
(312) 775-8000

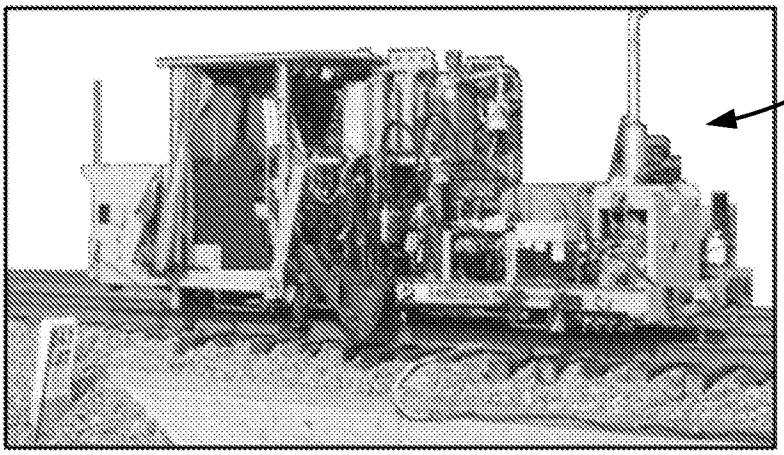


Fig. 1A

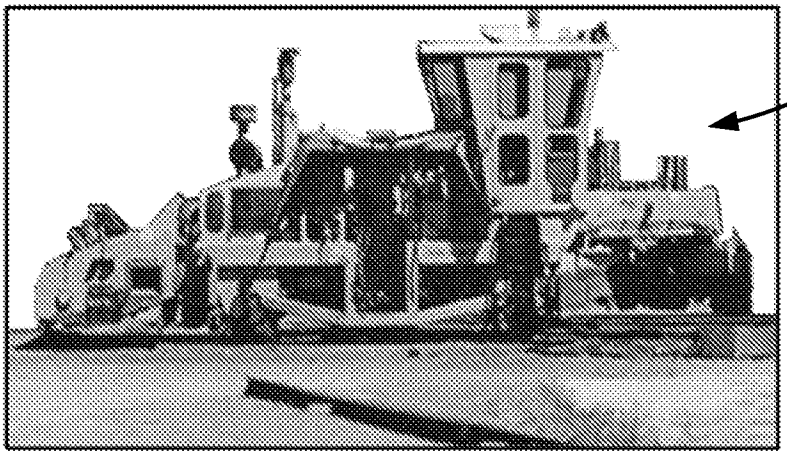


Fig. 1B

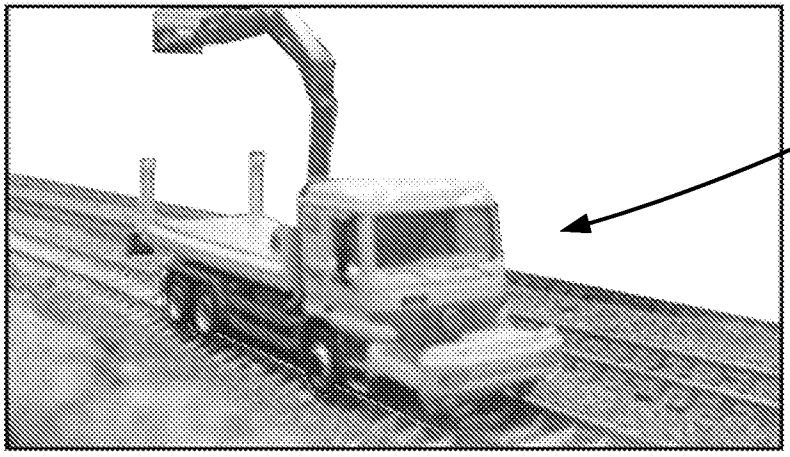
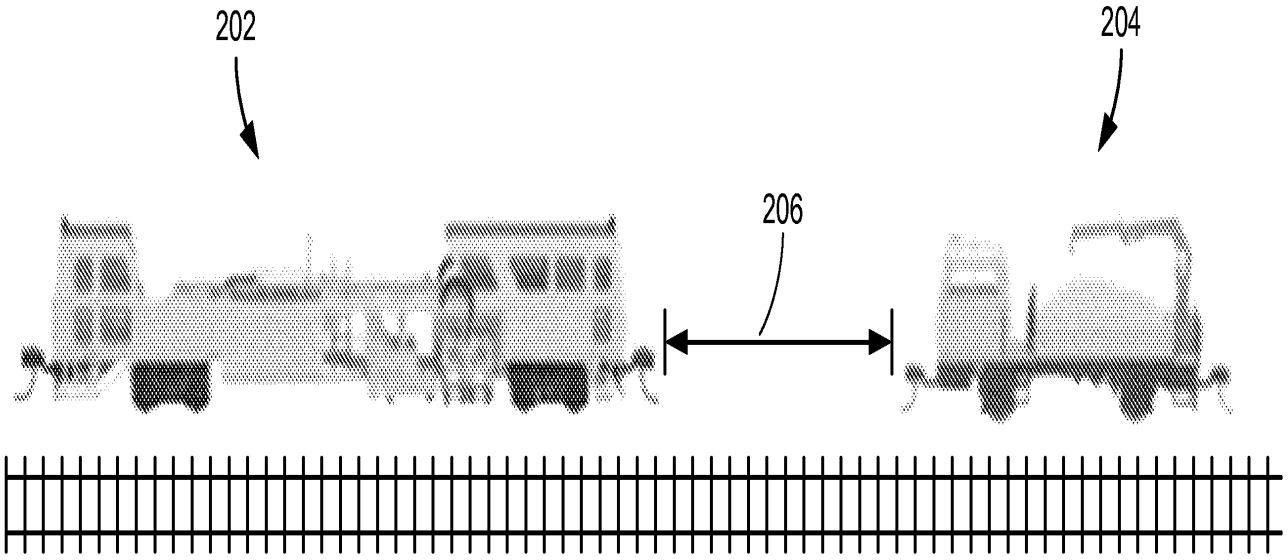


Fig. 1C

Fig. 2



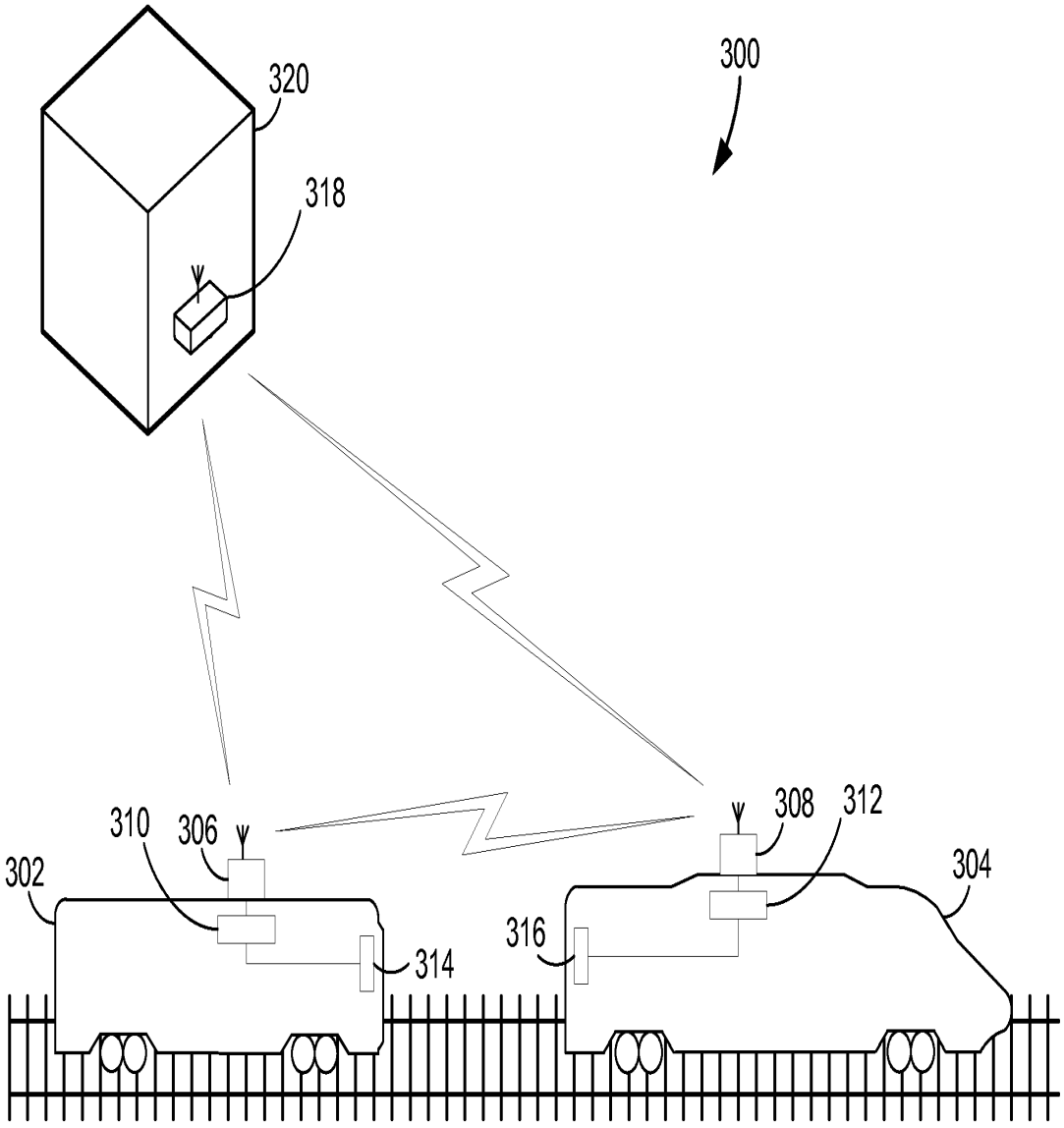


Fig. 3

Fig. 4

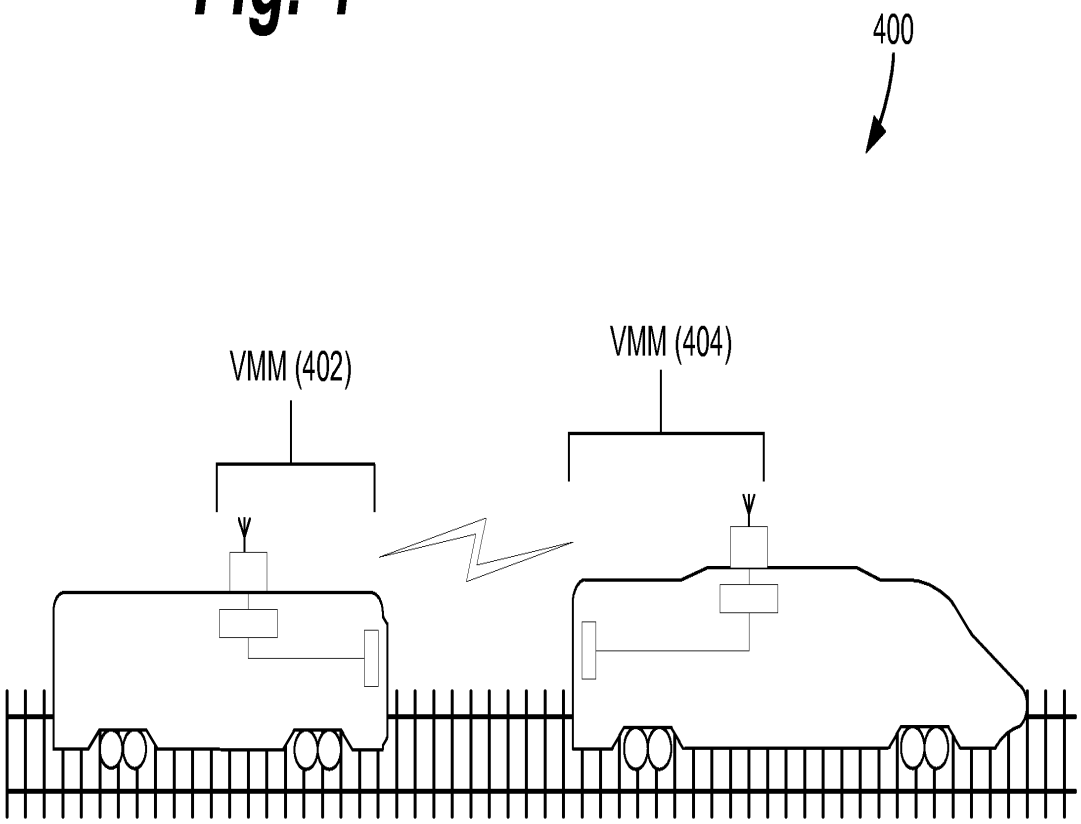
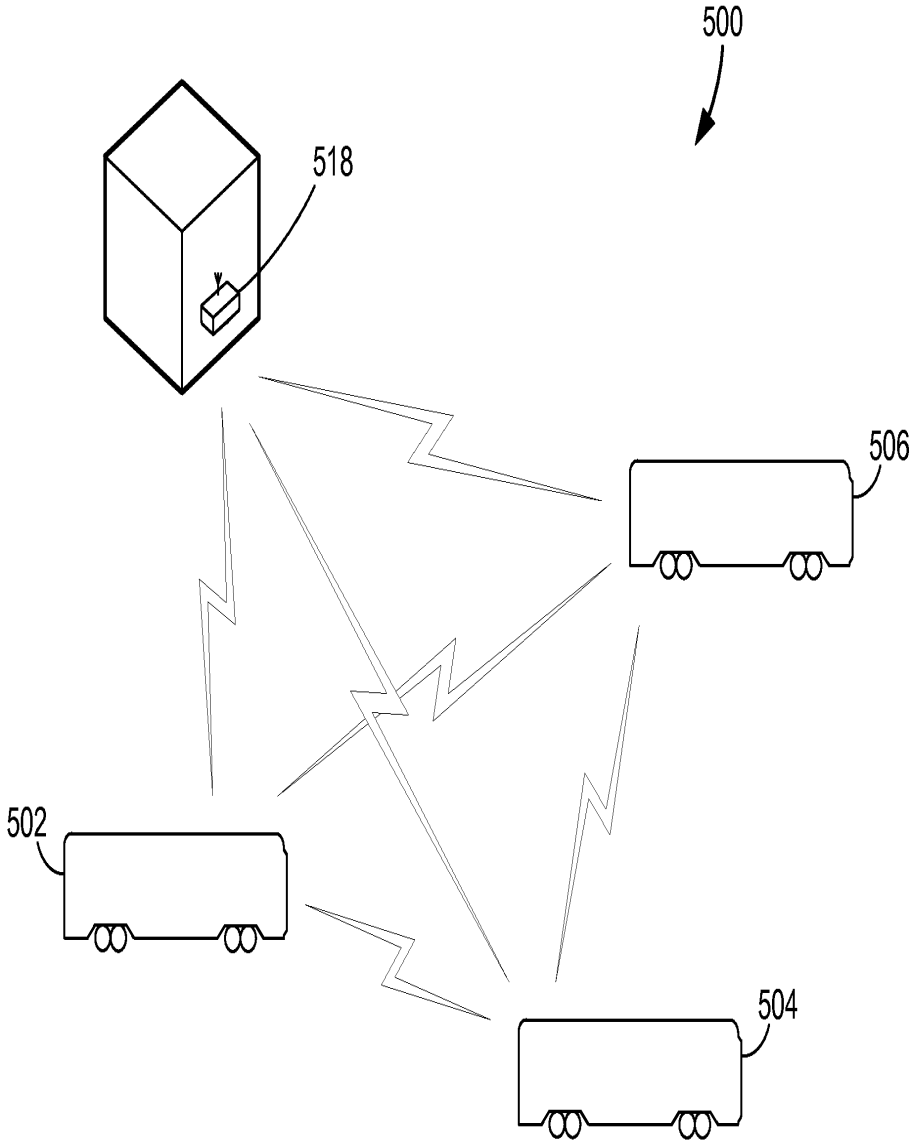


Fig. 5



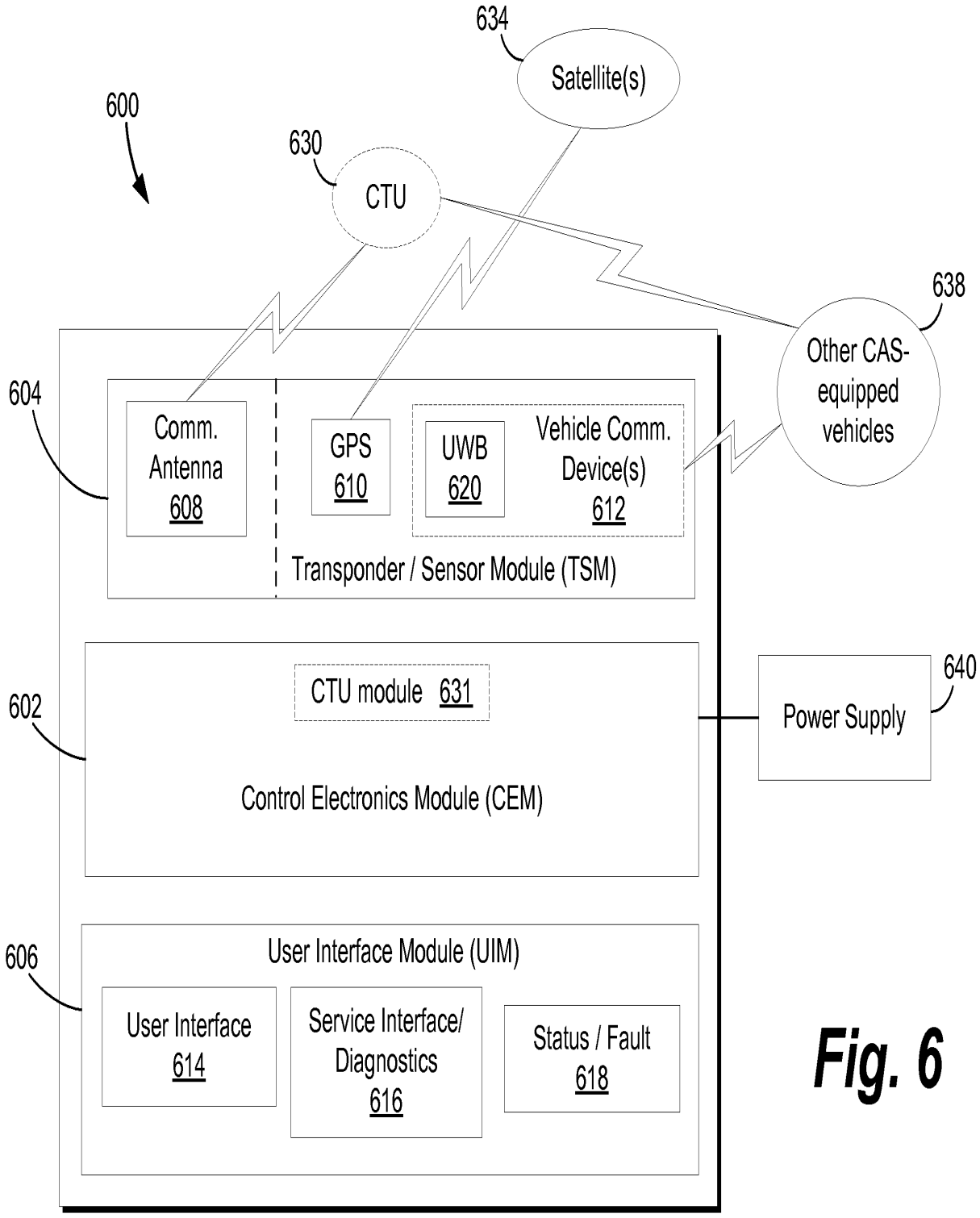
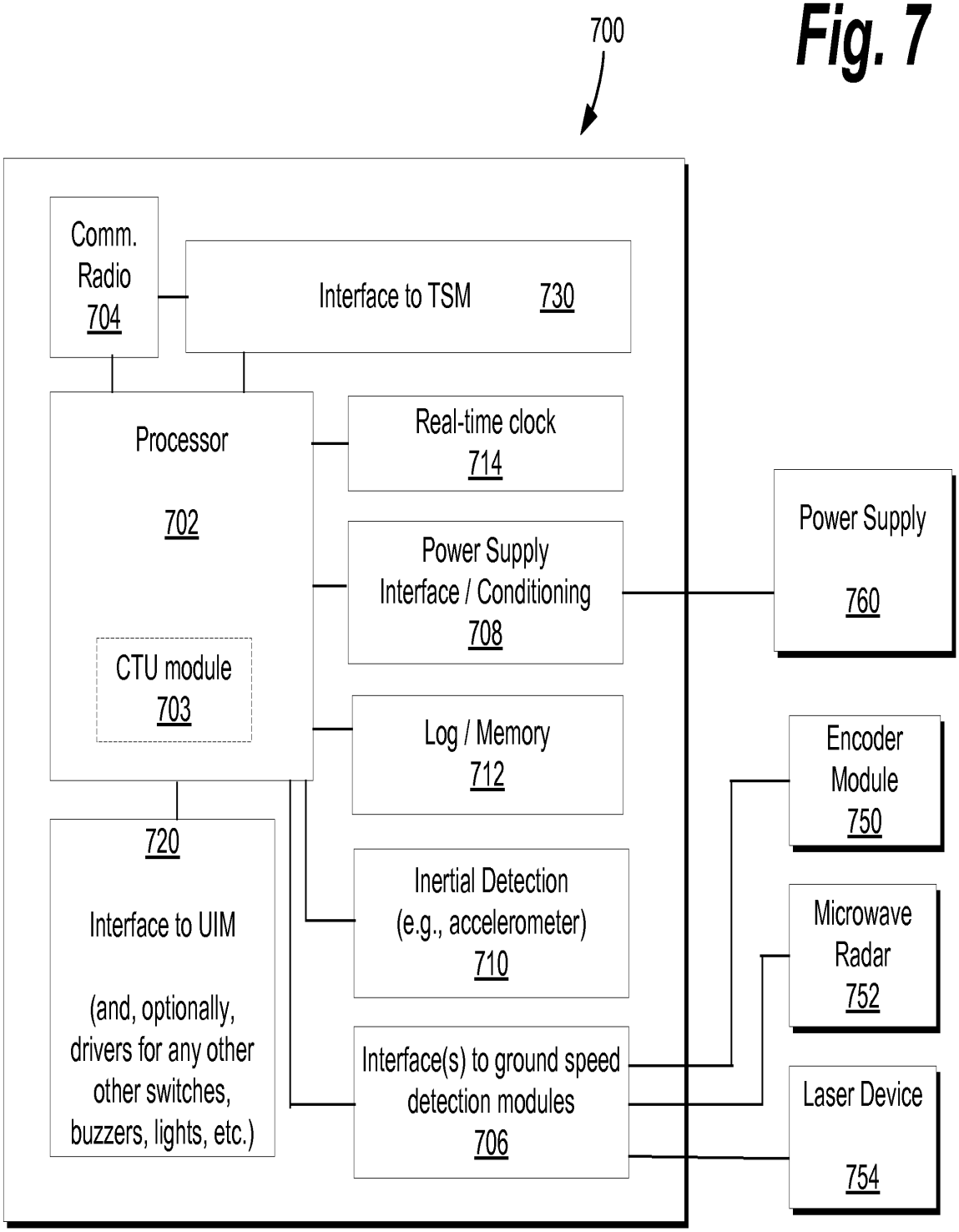

634
Satellite(s)
600
630
CTU
638
Other CAS-equipped vehicles
604
Comm. Antenna 608
GPS 610
UWB 620
Vehicle Comm. Device(s) 612
Transponder / Sensor Module (TSM)
602
CTU module 631
Control Electronics Module (CEM)
640
Power Supply
606
User Interface Module (UIM)
User Interface 614
Service Interface/ Diagnostics 616
Status / Fault 618

Fig. 6

6/15

Fig. 7


700
Comm. Radio 704
Interface to TSM 730
Processor 702
Real-time clock 714
Power Supply Interface / Conditioning 708
Power Supply 760
CTU module 703
Log / Memory 712
Encoder Module 750
720
Interface to UIM
(and, optionally, drivers for any other other switches, buzzers, lights, etc.)
Inertial Detection (e.g., accelerometer) 710
Microwave Radar 752
Interface(s) to ground speed detection modules 706
Laser Device 754

7/15

Fig. 8

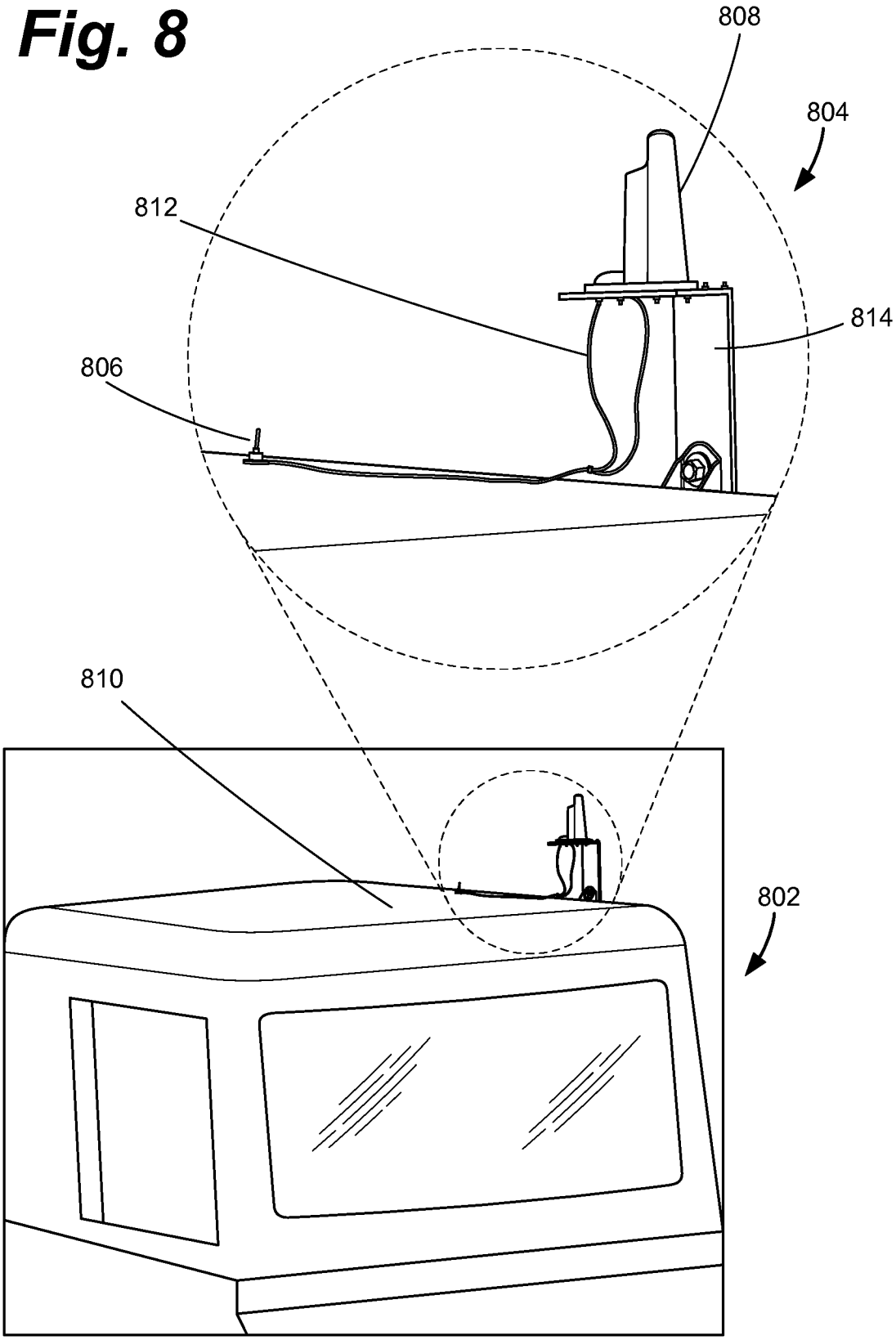
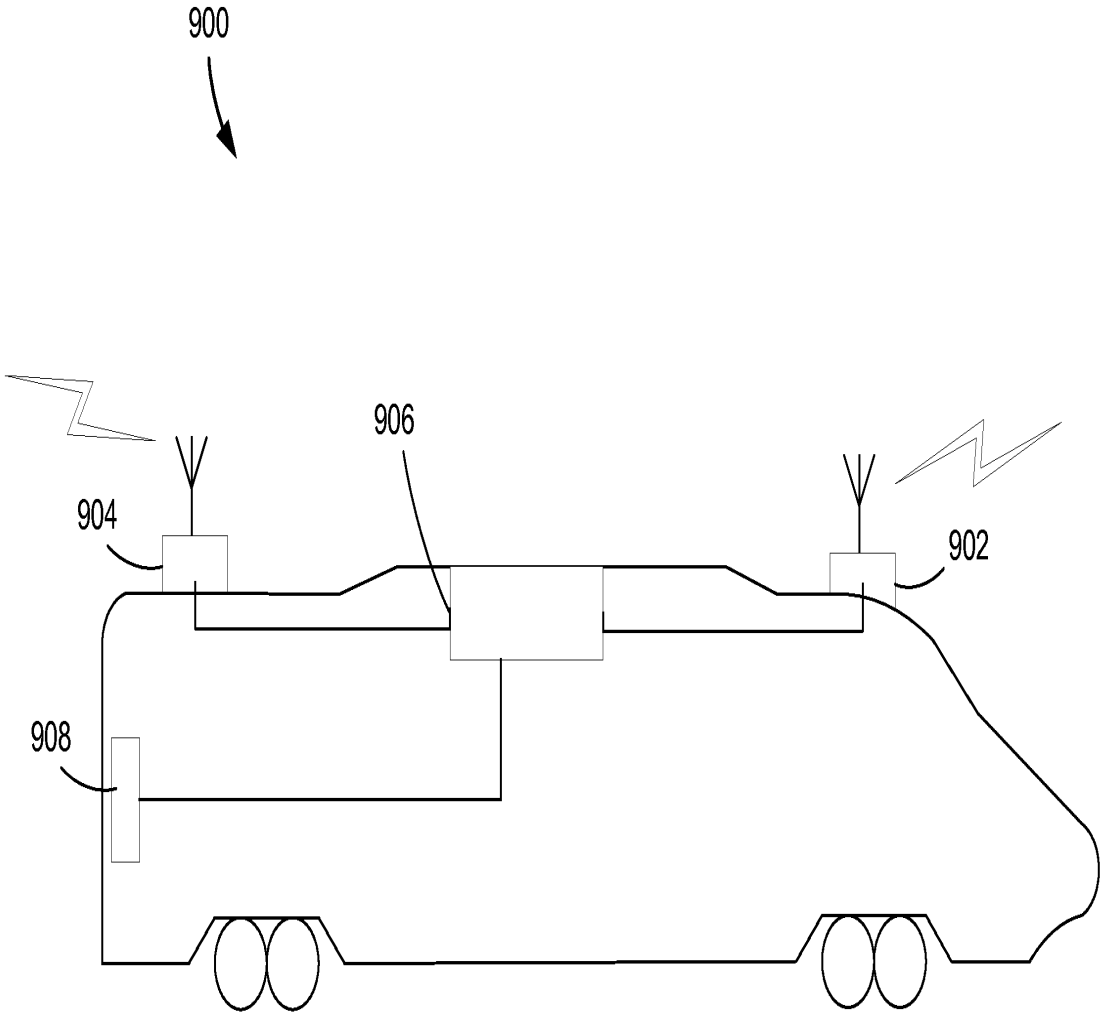


Fig. 9



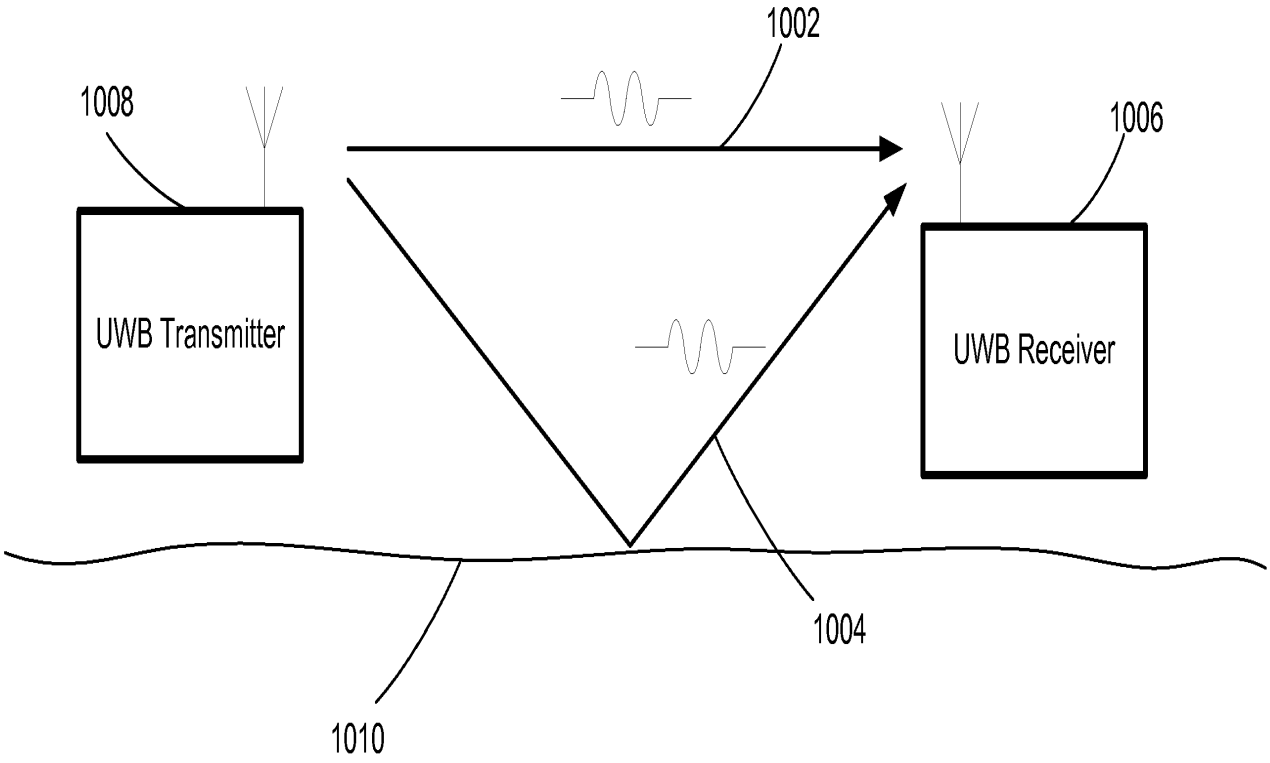


Fig. 10

Fig. 11

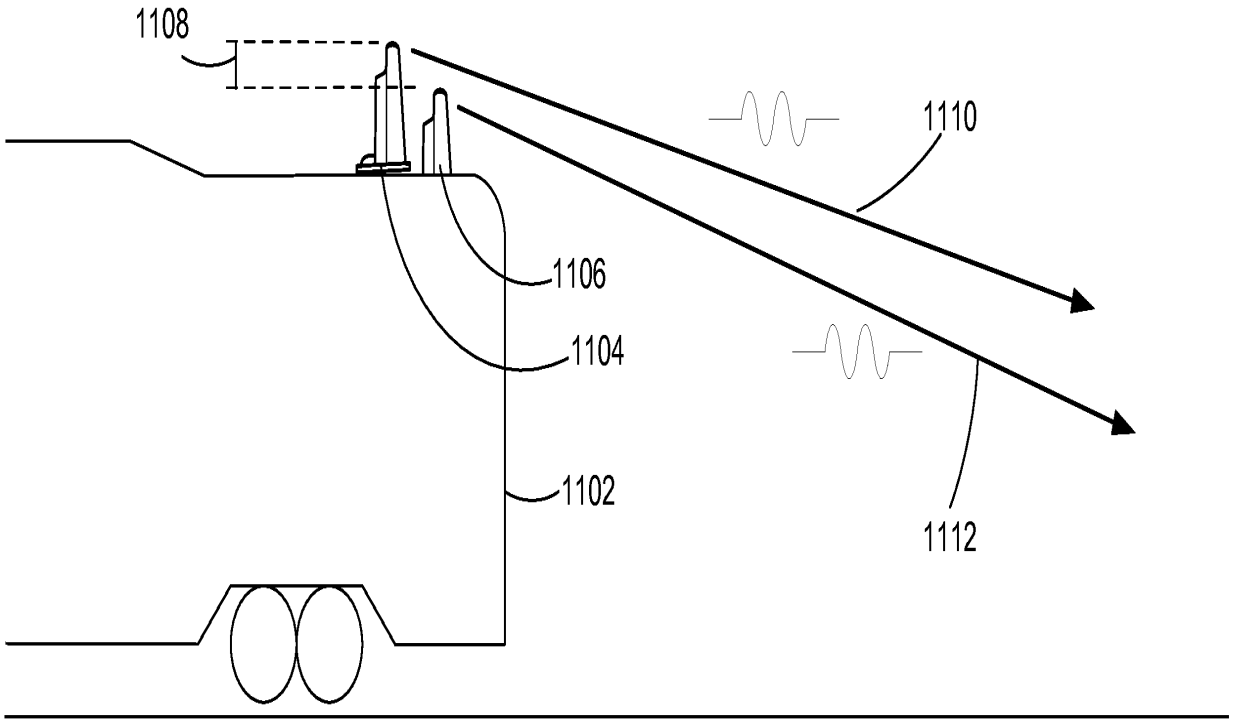


Fig. 12A

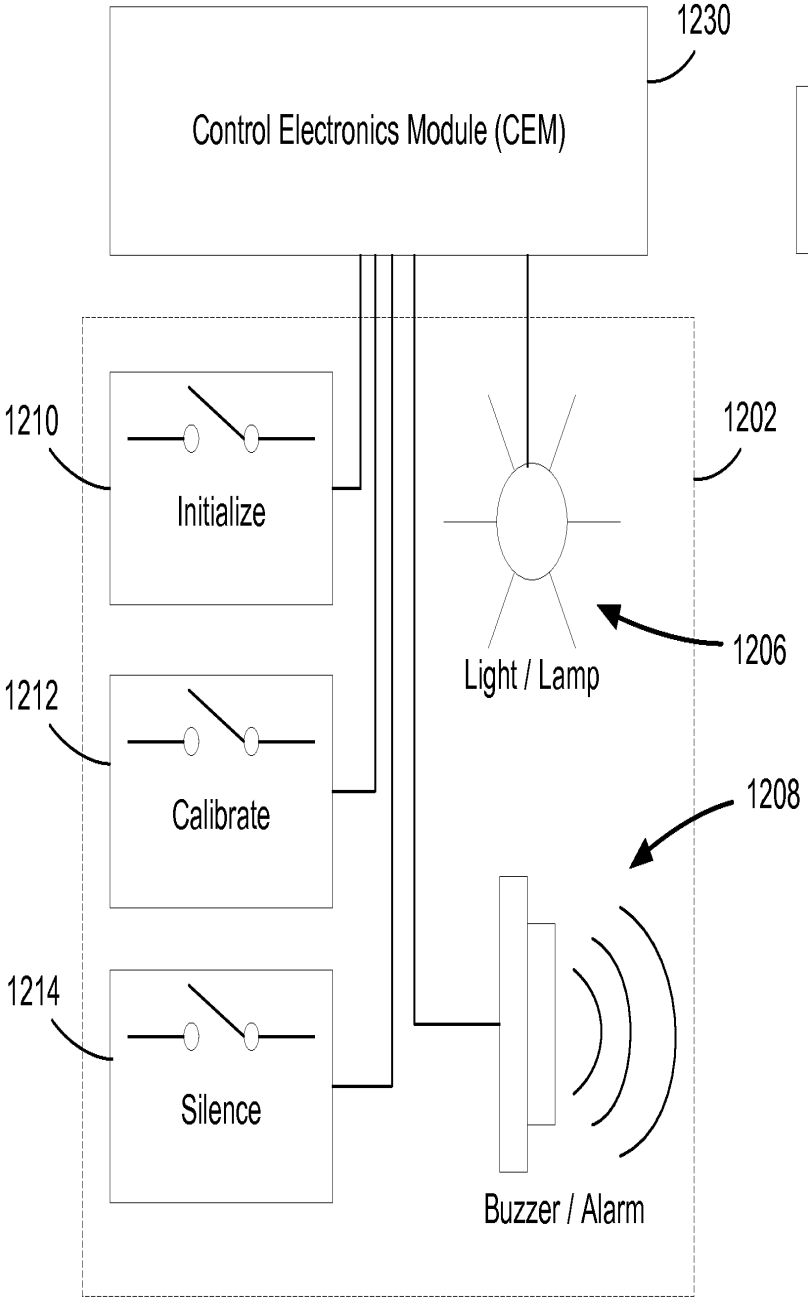
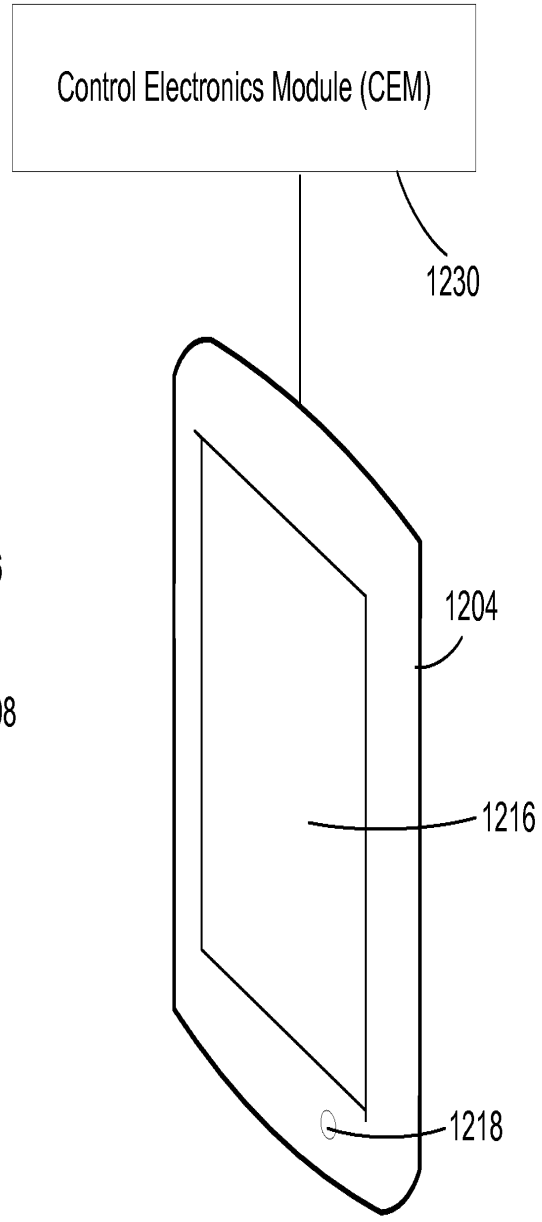


Fig. 12B



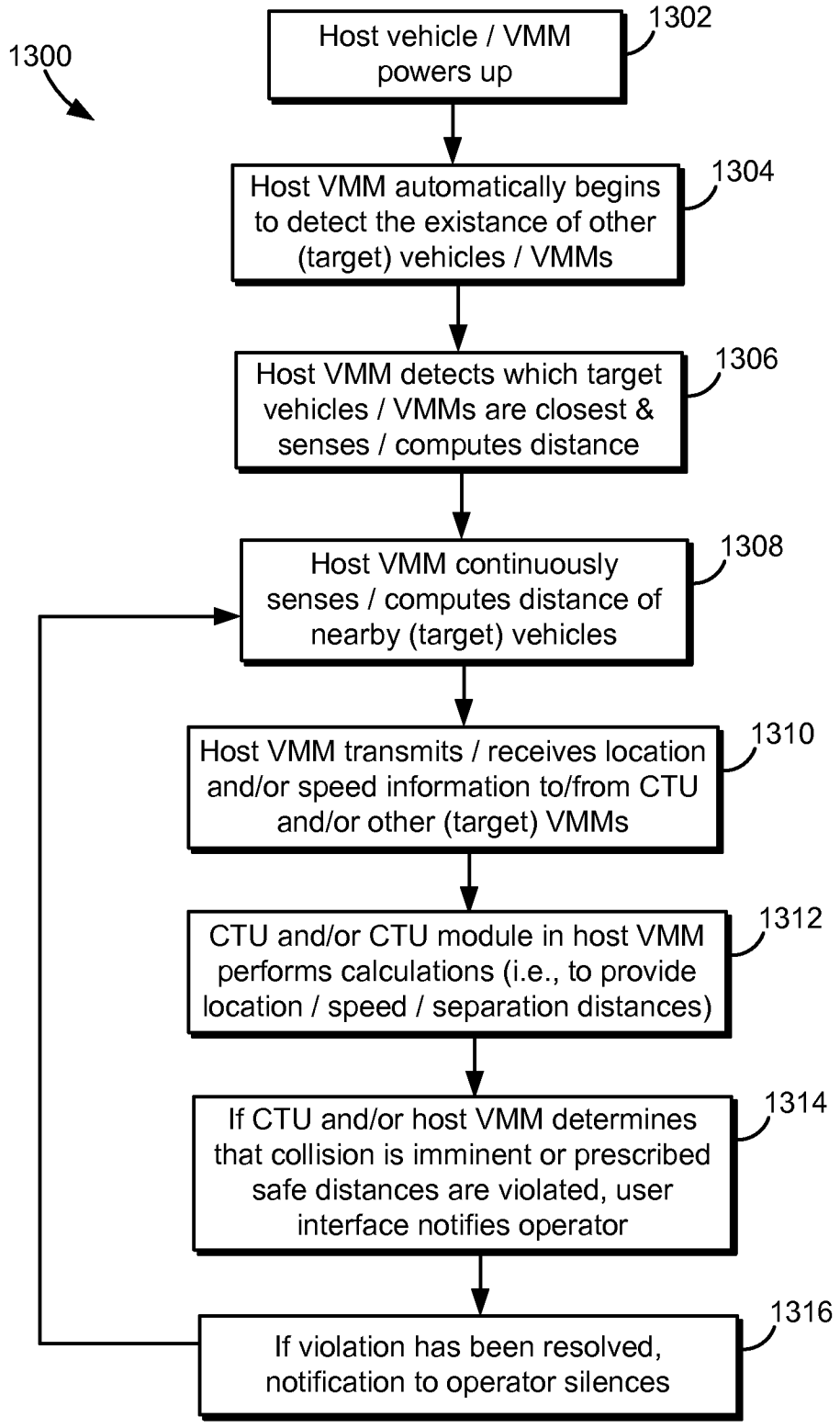

1300
Host vehicle / VMM powers up
1302
Host VMM automatically begins to detect the existance of other (target) vehicles / VMMs
1304
Host VMM detects which target vehicles / VMMs are closest & senses / computes distance
1306
Host VMM continuously senses / computes distance of nearby (target) vehicles
1308
Host VMM transmits / receives location and/or speed information to/from CTU and/or other (target) VMMs
1310
CTU and/or CTU module in host VMM performs calculations (i.e., to provide location / speed / separation distances)
1312
If CTU and/or host VMM determines that collision is imminent or prescribed safe distances are violated, user interface notifies operator
1314
If violation has been resolved, notification to operator silences
1316

Fig. 13

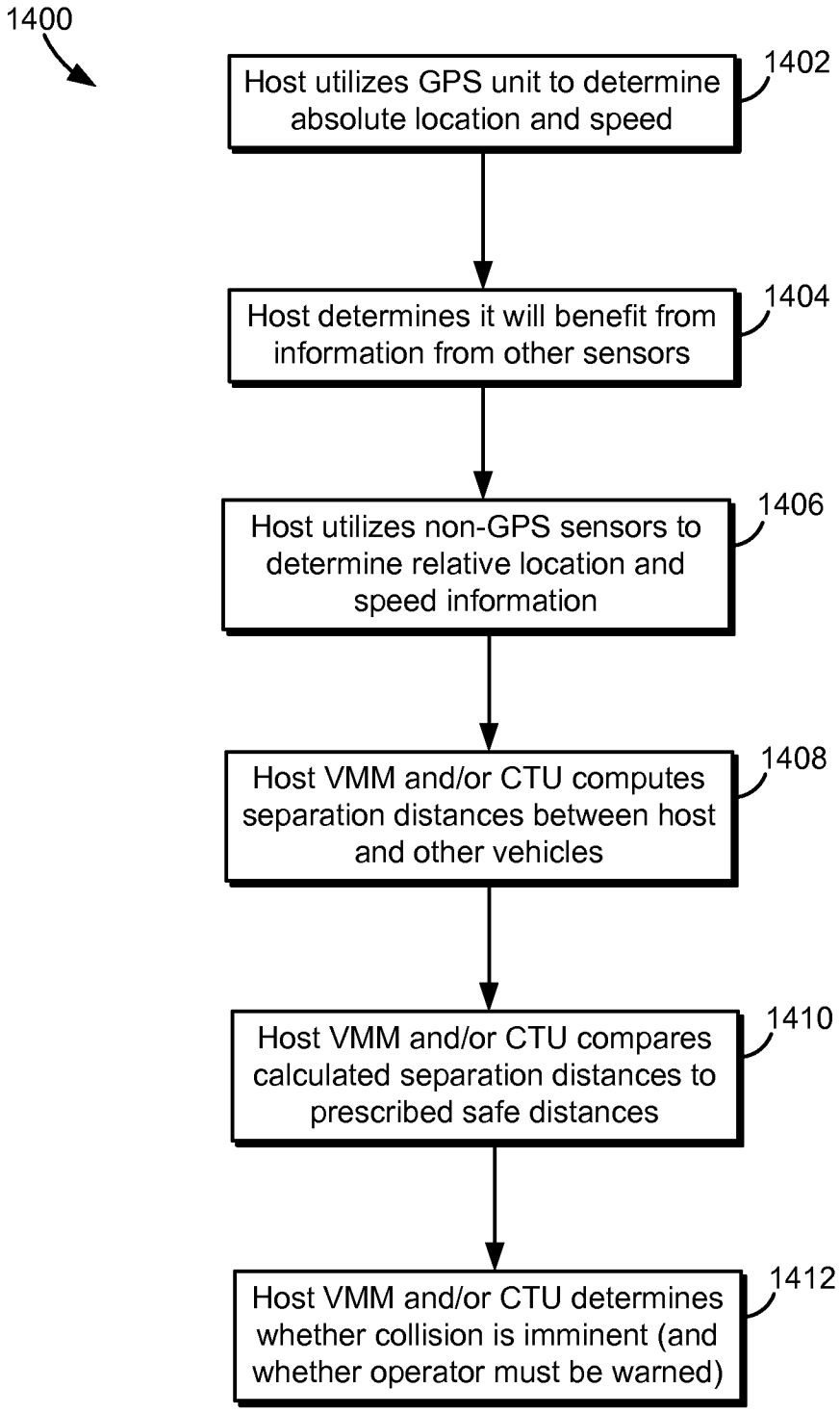

1400
Host utilizes GPS unit to determine absolute location and speed
1402
Host determines it will benefit from information from other sensors
1404
Host utilizes non-GPS sensors to determine relative location and speed information
1406
Host VMM and/or CTU computes separation distances between host and other vehicles
1408
Host VMM and/or CTU compares calculated separation distances to prescribed safe distances
1410
Host VMM and/or CTU determines whether collision is imminent (and whether operator must be warned)
1412

Fig. 14

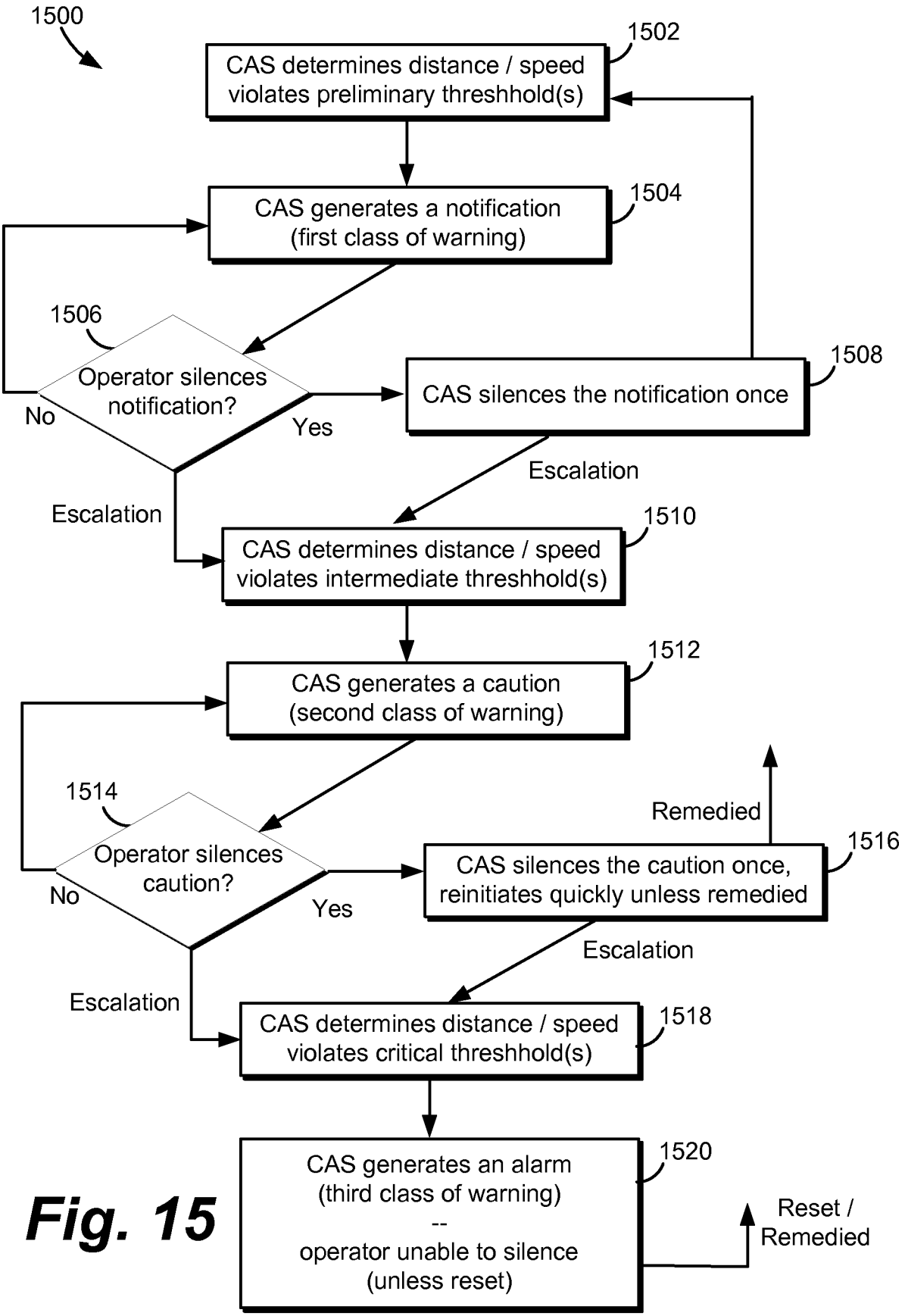

1500
1502
CAS determines distance / speed violates preliminary threshhold(s)
1504
CAS generates a notification (first class of warning)
1506
Operator silences notification?
No
Yes
1508
CAS silences the notification once
Escalation
Escalation
1510
CAS determines distance / speed violates intermediate threshhold(s)
1512
CAS generates a caution (second class of warning)
1514
Operator silences caution?
No
Yes
Remedied
1516
CAS silences the caution once, reinitiates quickly unless remedied
Escalation
Escalation
1518
CAS determines distance / speed violates critical threshhold(s)
1520
CAS generates an alarm (third class of warning) -- operator unable to silence (unless reset)
Reset / Remedied

Fig. 15

Electronic Acknowledgement Receipt

EFS ID:	12985289
Application Number:	13474428
International Application Number:	
Confirmation Number:	6724
Title of Invention:	COLLISION AVOIDANCE SYSTEM FOR RAIL LINE VEHICLES
First Named Inventor/Applicant Name:	Richard C. Carlson
Customer Number:	23446
Filer:	Jeb Anthony Shookman/Julia Villarreal
Filer Authorized By:	Jeb Anthony Shookman
Attorney Docket Number:	24983US02
Receipt Date:	11-JUN-2012
Filing Date:	17-MAY-2012
Time Stamp:	17:42:31
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Applicant Response to Pre-Exam Formalities Notice	24983US02_Response_to_Notice_to_File_Corrected_Papers.pdf	17595 49a2b97ff3316333a90e408abda5fb6c35d0607b	no	2

Warnings:	
Information:	

2	Drawings-only black and white line drawings	24983US02_REPLACEMENT_Drawings_1_to_15.pdf	282793 ab43d377bd5e0925a2667d179e8c839be3a4789a	no	15

Warnings:	
Information:	
Total Files Size (in bytes):	300388

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/81 (11-08)
Approved for use through 11/30/2011. OMB 0651-0035
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Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE THE USPTO

I hereby revoke all previous powers of attorney given in the application identified in the attached statement under 37 CFR 3.73(b).

I hereby appoint:

☑ Practitioners associated with the Customer Number: 23446

OR

☐ Practitioner(s) named below (if more than ten patent practitioners are to be named, then a customer number must be used):

Name	Registration Number		Name	Registration Number

as attorney(s) or agent(s) to represent the undersigned before the United States Patent and Trademark Office (USPTO) in connection with any and all patent applications assigned only to the undersigned according to the USPTO assignment records or assignment documents attached to this form in accordance with 37 CFR 3.73(b).

Please change the correspondence address for the application identified in the attached statement under 37 CFR 3.73(b) to:

☑ The address associated with Customer Number: 23446

OR

☐ Firm or Individual Name			
Address			
City		State	Zip
Country			
Telephone		Email	

Assignee Name and Address:

Metrom Rail, LLC
220 Telser Road Lake Zurich, IL 60047

A copy of this form, together with a statement under 37 CFR 3.73(b) (Form PTO/SB/96 or equivalent) is required to be filed in each application in which this form is used. The statement under 37 CFR 3.73(b) may be completed by one of the practitioners appointed in this form if the appointed practitioner is authorized to act on behalf of the assignee, and must identify the application in which this Power of Attorney is to be filed.

SIGNATURE of Assignee of Record

The individual whose signature and title is supplied below is authorized to act on behalf of the assignee

Signature	Jim March	Date	5-24-12
Name	Jim March	Telephone	847-847-2057
Title	Chief Executive Officer		

The collection of information is required by 37 CFR 1.31, 1.32 and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

DECLARATION REGARDING AUTHORITY TO SIGN
ON BEHALF OF A LEGAL ENTITY
37 C.F.R. 3.73(b)(2)(i)

I, Tim Marchi (whose title is supplied below), hereby declare that I am authorized to sign documents on behalf of Metrom Rail, LLC.

Signature of Authorized Person

Chief Executive Officer
Title

5-24-12
Date

Electronic Acknowledgement Receipt

EFS ID:	12985425
Application Number:	13474428
International Application Number:	
Confirmation Number:	6724
Title of Invention:	COLLISION AVOIDANCE SYSTEM FOR RAIL LINE VEHICLES
First Named Inventor/Applicant Name:	Richard C. Carlson
Customer Number:	23446
Filer:	Jeb Anthony Shookman/Julia Villarreal
Filer Authorized By:	Jeb Anthony Shookman
Attorney Docket Number:	24983US02
Receipt Date:	11-JUN-2012
Filing Date:	17-MAY-2012
Time Stamp:	17:50:47
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Assignee showing of ownership per 37 CFR 3.73(b).	24983US02_3_73b.pdf	423025 8a9923fe844438e800ed4d3017d7a41e7068d69e	no	2

Warnings:	
Information:	

2	Power of Attorney	METROM_POA_Executed.pdf	257318 b4214ccc27fe71f427842aaeaaa7347ce418e16c	no	2

Warnings:	
Information:	
Total Files Size (in bytes):	680343

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/96 (07-09)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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STATEMENT UNDER 37 CFR 3.73(b)

Applicant/Patent Owner: Metrom Rail, LLC

Application No./Patent No.: 13/474,428 Filed/Issue Date: May 17, 2012

Titled: COLLISION AVOIDANCE SYSTEM

Metrom Rail, LLC , a LLC (Limited Liability Company)

(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.

states that it is:

1. ☒ the assignee of the entire right, title, and interest in;

2. ☐ an assignee of less than the entire right, title, and interest in (The extent (by percentage) of its ownership interest is _____ %); or

3. ☐ the assignee of an undivided interest in the entirety of (a complete assignment from one of the joint inventors was made)

the patent application/patent identified above, by virtue of either:

A. ☒ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel 028233, Frame 0175, or for which a copy therefore is attached.

OR

B. ☐ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

2. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

3. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☒ As required by 37 CFR 3.73(b)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (*i.e.*, a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/Jeb A. Shookman/ June 11, 2012

Signature Date

Jeb A. Shookman, Registration No. 67793 Attorney/Agent

Printed or Typed Name Title

This collection of information is required by 37 CFR 3.73(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

SCORE Placeholder Sheet for IFW Content

Application Number: 13474428 Document Date: 6/11/2012

The presence of this form in the IFW record indicates that the following document type was received in electronic format on the date identified above. This content is stored in the SCORE database.

- Drawings – Other than Black and White Line Drawings

Since this was an electronic submission, there is no physical artifact folder, no artifact folder is recorded in PALM, and no paper documents or physical media exist. The TIFF images in the IFW record were created from the original documents that are stored in SCORE.

To access the documents in the SCORE database, refer to instructions developed by SIRA.

At the time of document entry (noted above):

- Examiners may access SCORE content via the eDAN interface.
- Other USPTO employees can bookmark the current SCORE URL (http://es/ScoreAccessWeb/).
- External customers may access SCORE content via the Public and Private PAIR interfaces.

Form Revision Date: February 8, 2006

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
13/474,428	05/17/2012	3617	650	24983US02	24	2

CONFIRMATION NO. 6724

UPDATED FILING RECEIPT

23446
MCANDREWS HELD & MALLOY, LTD
500 WEST MADISON STREET
SUITE 3400
CHICAGO, IL 60661

OC000000054840327

Date Mailed: 06/18/2012

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Applicant(s)

Richard C. Carlson, Wauconda, IL;
Kurt A. Gunther, Round Lake Heights, IL;
Marc W. Cygnus, Mundelein, IL;

Power of Attorney: The patent practitioners associated with Customer Number 23446

Domestic Priority data as claimed by applicant

This appln claims benefit of 61/598,750 02/14/2012
and claims benefit of 61/627,697 10/17/2011
and claims benefit of 61/519,201 05/19/2011

Foreign Applications (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.)

If Required, Foreign Filing License Granted: 05/29/2012

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 13/474,428**

Projected Publication Date: 11/22/2012

Non-Publication Request: No

Early Publication Request: No
** **SMALL ENTITY** **

Title

COLLISION AVOIDANCE SYSTEM FOR RAIL LINE VEHICLES

Preliminary Class

104

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4158).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as

set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

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The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation and commercialization of new technologies. The USA offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to encourage, facilitate, and accelerate business investment. To learn more about why the USA is the best country in the world to develop technology, manufacture products, and grow your business, visit SelectUSA.gov.

UNITED STATES PATENT AND TRADEMARK OFFICE

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
13/474,428	05/17/2012	Richard C. Carlson	24983US02

CONFIRMATION NO. 6724

23446
MCANDREWS HELD & MALLOY, LTD
500 WEST MADISON STREET
SUITE 3400
CHICAGO, IL 60661

POA ACCEPTANCE LETTER

OC000000054840355

Date Mailed: 06/18/2012

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 06/11/2012.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

/tchaka/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 13/474,428

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	95		N/A	
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	310		N/A	
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	125		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	24 minus 20 =	* 4	x 30 =	120	OR		
INDEPENDENT CLAIMS (37 CFR 1.16(h))	2 minus 3 =	*	x 125 =	0.00			
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			0.00			
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				0.00			
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	650		TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT A	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE($)	ADDITIONAL FEE($)		RATE($)	ADDITIONAL FEE($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	13474428
Filing Date	2012-05-17
First Named Inventor	Richard C. Carlson, et al.
Art Unit	3617
Examiner Name	TBD
Attorney Docket Number	24983US02

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1					

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1					

If you wish to add additional U.S. Published Application citation information please click the Add button. Add

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2]	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1							☐

If you wish to add additional Foreign Patent Document citation information please click the Add button Add

NON-PATENT LITERATURE DOCUMENTS Remove

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	13474428
	Filing Date	2012-05-17
	First Named Inventor	Richard C. Carlson, et al.
	Art Unit	3617
	Examiner Name	TBD
	Attorney Docket Number	24983US02

	1	International Search Report and Written Opinion of the International Searching Authority, International Application No. PT/US12/38332, International Filing Date May 17, 2012, METROM RAIL, dated July 13, 2012, 24983WO01	☐

If you wish to add additional non-patent literature document citation information please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	13474428
	Filing Date	2012-05-17
	First Named Inventor	Richard C. Carlson, et al.
	Art Unit	3617
	Examiner Name	TBD
	Attorney Docket Number	24983US02

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Jeb A. Shookman/	Date (YYYY-MM-DD)	2012-09-12
Name/Print	Jeb A. Shookman	Registration Number	67793

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 24983WO01	**FOR FURTHER ACTION**	see Form PCT/ISA/220 as well as, where applicable, item 5 below.
International application No. PCT/US 12/38332	International filing date *(day/month/year)* 17 May 2012 (17.05.2012)	(Earliest) Priority Date *(day/month/year)* 19 May 2011 (19.05.2011)
Applicant METROM RAIL, LLC		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 2 sheets.

☐ It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

   a. With regard to the **language**, the international search was carried out on the basis of:

   ☒ the international application in the language in which it was filed.

   ☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

   b. ☐ This international search report has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43.6*bis*(a)).

   c. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2. ☐ **Certain claims were found unsearchable** (see Box No. II).

3. ☐ **Unity of invention is lacking** (see Box No. III).

4. With regard to the **title**,

   ☒ the text is approved as submitted by the applicant.

   ☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

   ☒ the text is approved as submitted by the applicant.

   ☐ the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. With regard to the **drawings**,

   a. the figure of the **drawings** to be published with the abstract is Figure No. 1

   ☒ as suggested by the applicant.

   ☐ as selected by this Authority, because the applicant failed to suggest a figure.

   ☐ as selected by this Authority, because this figure better characterizes the invention.

   b. ☐ none of the figures is to be published with the abstract.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 12/38332

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - G06F 17/10 (2012.01)
USPC - 701/301
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
USPC: 701/301
IPC(8): G06F 17/10 (2012.01)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
USPC: 701/301, 19 (Keyword limited; terms below)
IPC(8): G06F 17/10 (2012.01) (Keyword limited; terms below)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PubWEST (PGPB, USPT, EPAB, JPAB); Google (Scholar, Patents, Web)
Terms used: rail vehicle sensor distance vehicle-mounted transponder ultra wideband between vehicles operator interface tracking unit touchscreen

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 2008/0150786 A1 (BREED), 26 June 2008 (26.06.2008), entire document, especially Abstract, para [0078], [0114], [0135], [0139], [0155], [0159], [0183], [0213]-[0214], [0272], [0309], [0366], [0368], [0397], [0502]-[0503]	1-10, 13, and 17-24 --- 11-12, 14-16
Y	US 2006/0025897 A1 (SHOSTAK et al.), 02 February 2006 (02.02.2006), entire document, especially Abstract, para [0916], [0979]-[0980], [1555]	11-12, 14
Y	US 2010/0207787 A1 (CATTEN et al.), 19 August 2010 (19.08.2010), entire document, especially Abstract, para [0050], [0061]	15-16
A	US 6,295,019 B1 (RICHARDS et al.), 25 September 2001 (25.09.2001), entire document	1-24
A	US 2003/0028323 A1 (ZEITER et al.), 06 February 2003 (06.02.2003), entire document	1-24
A	US 2006/0151672 A1 (HEDDEBAUT et al.), 13 July 2006 (13.07.2006), entire document, especially Abstract, para [0054]-[0060]	1-24
A	US 2009/0173839 (GROENEWEG et al.), 09 July 2009 (09.07.2009), entire document	1-24
A	US 2010/0225527 A1 (TALTY et al.), 09 September 2010 (09.09.2010), entire document	1-24
T	US 2012/0138752 A1 (CARLSON et al.), 07 June 2012 (07.06.2012), entire document	1-24

☐ Further documents are listed in the continuation of Box C. ☐

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
02 July 2012 (02.07.2012)	13 JUL 2012
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (July 2009)

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To: JEB A. SHOOKMAN
MCANDREWS HELD AND MALLOY
500 W. MADISON, SUITE 3400
CHICAGO, IL 60661

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing *(day/month/year)*	13 JUL 2012
Applicant's or agent's file reference 24983WO01	**FOR FURTHER ACTION** See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US 12/38332	17 May 2012 (17.05.2012)	19 May 2011 (19.05.2011)

International Patent Classification (IPC) or both national classification and IPC
IPC(8) - G06F 17/10 (2012.01)
USPC - 701/301

Applicant METROM RAIL, LLC

1. This opinion contains indications relating to the following items:

- [X] Box No. I Basis of the opinion
- [ ] Box No. II Priority
- [ ] Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- [ ] Box No. IV Lack of unity of invention
- [X] Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- [ ] Box No. VI Certain documents cited
- [ ] Box No. VII Certain defects in the international application
- [ ] Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1 *bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Fom PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA/US	Date of completion of this opinion	Authorized officer:
Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	03 July 2012 (03.07.2012)	Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/237 (cover sheet) (July 2011)

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 12/38332

Box No. I Basis of this opinion

1. With regard to the **language**, this opinion has been established on the basis of:

   ☒ the international application in the language in which it was filed.

   ☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(a))

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing filed or furnished:

   a. (means)

   ☐ on paper

   ☐ in electronic form

   b. (time)

   ☐ in the international application as filed

   ☐ together with the international application in electronic form

   ☐ subsequently to this Authority for the purposes of search

4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 12/38332

Box No. V **Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Claims	11-12, 14-16	YES
	Claims	1-10, 13, 17-24	NO
Inventive step (IS)	Claims	None	YES
	Claims	1-24	NO
Industrial applicability (IA)	Claims	1-24	YES
	Claims	None	NO

2. Citations and explanations:

Claims 1-10, 13, and 17-24 lack novelty under PCT Article 33(2) as being anticipated by US 2008/0150786 A1 to Breed.

As to claim 1, Breed teaches a rail line vehicle having a vehicle mounted module, the vehicle mounted module comprising a transponder sensor module including an ultra wideband unit and a wireless communications antenna, wherein the ultra wideband unit is operable to detect a distance between the rail line vehicle and at least one other vehicle, wherein the wireless communications antenna is operable to send and receive data over the air ("Vehicle 18 contains two receivers 160,161 for the micropower impulse radar (MIR) implementation of the invention. MIR or ultrawideband (UWB) transmitter devices are placed at locations 151, 152 and 153 respectively," para [0183]); a control electronics module including a processor that is in communication with at least the ultra wideband unit ("A vehicle 246 includes an antenna 248 coupled to a control module, control unit, processor or computer 250. The antenna, which can be an imager, 248 receives transmissions (waves or wireless signals) including transmissions 252 when in range of the transmitters," para [0213]); and a user interface module including a user interface, wherein the user interface is operable to provide a vehicle operator with information and is operable to accept input from the vehicle operator ("a user input device on the vehicle which enables an occupant of the vehicle to request information to be transmitted via the transmitter," para [0366]).

As to claim 2, Breed teaches the rail line vehicle of claim 1 wherein the vehicle mounted module is in communication with one or more central tracking units by way of the wireless communications antenna, wherein the one or more central tracking units are operable to track the location of the rail line vehicle and at least one other vehicle ("communications with precise positioning stations for GPS independent location determination," para [0368]).

As to claim 3, Breed teaches the rail line vehicle of claim 1 wherein the vehicle mounted module further comprises a central tracking unit module that is operable to track the location of at least one other vehicle (" management of the database may include transmitting from the vehicle requests, for example, to other vehicles, a central map management facility or infrastructure, to ascertain whether the database has current map data for the current location of the vehicle and surrounding locations," para [0155]; "The system described herein also permits better simultaneous tracking of several vehicles," para [0309]).

As to claim 4, Breed teaches the rail line vehicle of claim 1 wherein the transponder sensor module further includes a global positioning system, wherein the global positioning system is operable to receive information from one or more satellites and is operable to determine the absolute position of the rail line vehicle ("initially, it is preferred to use the GPS navigational satellites as the base technology," para [0159]).

As to claim 5, Breed teaches the rail line vehicle of claim 4 wherein the vehicle mounted module is operable to utilize information generated by the global positioning system and the ultra wideband unit to determine whether one or more vehicle separation criteria are violated, and generate a warning if one or more vehicle separation criteria are violated ("the extraction of information from radio frequency wave transmission may be limited based on a threshold determination (a filter of sorts) as to whether the transmission is of potential interest, e.g., to the operation of the vehicle based on its position, location and/or motion," para [0214]; "Other reactive systems 265 are also envisioned, e.g., a warning system to warn the driver of the vehicle about the presence of another vehicle within a threshold distance form the vehicle," para [0272]).

As to claim 6, Breed teaches the rail line vehicle of claim 1 wherein the user interface module further includes a service interface operable to allow the vehicle operator to configure, calibrate, service, maintain, diagnose, update and/or install information on vehicle mounted module ("calibration system," para [0200]; "the diagnostic or prognostic determination is transmitted from the vehicle to a transmitter which in turn can direct the determination to a dealer, manufacturer, vehicle owner and/or service center," para [0368]; "diagnostic and prognostic telematics communications," para [0397]).

As to claim 7, Breed teaches the rail line vehicle of claim 1 wherein the control electronics module further includes one or more interfaces that are operable to communicate with ground speed detection modules ("ground speed monitoring system using lasers, radar or ultrasonics," para [0502]).

As to claim 8, Breed teaches the rail line vehicle of claim 7 wherein the ground speed detection modules include one or more of a microwave radar, a laser device, an infrared sensor and an ultra wideband sensor (para [0502]).

(PLEASE SEE SUPPLEMENTAL BOX)

Supplemental Box

In case **the space in any of the preceding boxes is not sufficient.**
Continuation of:
Box V.2 - Citations and explanations:

As to claim 9, Breed teaches the rail line vehicle of claim 1 wherein the control electronics module further includes one or more inertial measurement units ("The inertial navigation system (INS), sometimes called the inertial reference unit or IRU, comprises one or more accelerometers 78 and one or more gyroscopes," para [0503]).

As to claim 10, Breed teaches the rail line vehicle of claim 1 wherein the vehicle mounted modules comprises one or more additional transponder sensor modules, wherein the vehicle mounted module is operable to accept calibration information regarding the length of the rail line vehicle and the mounting locations of the transponder sensor module and the one or more additional transponder sensor modules ("Extension assembly 214 can include a mounting bracket 216 from the roof of the vehicle 200 forward to each data acquisition module 210, a mounting bracket 218 extending from the front bumper upward to each data acquisition module 202 and a cross mounting bracket 220 extending between the data acquisition modules 202 for support. Since all of the data acquisition equipment is co-located, its precise location is accurately determined by the IMU, the mounting location on the vehicle and the differential GPS system," para [0139]).

As to claim 13, Breed teaches the rail line vehicle of claim 1 wherein the transponder sensor module further includes one or more of a laser device, a radar sensor and an infrared sensor (para [0502]).

As to claim 17, Breed teaches the rail line vehicle of claim 1 wherein the vehicle mounted module is operable to utilize a stopping distance calibration feature that measures a stopping distance, wherein the stopping distance indicates how quickly the rail line vehicle can stop under current conditions ("Range-gating on the imaging system or reflection measurements on the laser radar units can be used to measure the driver's sight distance and the speed of the vehicle can then be limited to a speed that allows for a safe stopping distance between the vehicle and another vehicle or object that may be in the path of the vehicle or on a collision path with the vehicle," para [0272]).

As to claim 18, Breed teaches the rail line vehicle of claim 17 wherein the measured stopping distance is used to modify one or more safe separation distance thresholds ("if a faster moving vehicle approaches a slower moving vehicle, it will automatically slow down to keep a safe separation distance from the leading, slower moving vehicle," para [0078]).

As to claim 19, Breed teaches the rail line vehicle of claim 1 wherein the control electronics module further includes an inertial measurement unit (para [0503]).

As to claim 20, Breed teaches a collision avoidance system comprising: one or more vehicle mounted modules, each mounted on a vehicle, each vehicle mounted module comprising: a transponder sensor module including an ultra wideband unit and a wireless communications antenna, wherein the ultra wideband unit is operable to detect a distance between the vehicle on which the vehicle mounted module is mounted and at least one other vehicle, wherein the wireless communications antenna is operable to send and receive data over the air (para [0183]); a control electronics module including a processor that is in communication with at least the ultra wideband unit (para [0213]); and a user interface module including a user interface, wherein the user interface is operable to provide a vehicle operator with information and is operable to accept input from the vehicle operator (para [0366]); and a central tracking unit that is in communication with the one or more vehicle mounted modules, the central tracking unit being operable to track the location of the one or more vehicle mounted modules (para [0368]).

As to claim 21, Breed teaches the collision avoidance system of claim 20 wherein the central tracking unit is distributed among the one or more vehicle mounted modules, wherein each of the one or more vehicle mounted modules includes a central tracking unit component, each central tracking unit component is in communication with the vehicle's control electronics module (para [0135], [0139]).

As to claim 22, Breed teaches the collision avoidance system of claim 20 wherein the central tracking unit is disposed in a discrete housing ("Such a device typically has three accelerometers and three gyroscopes that are held together in a single housing," para [0114]).

As to claim 23, Breed teaches the collision avoidance system of claim 20 wherein the transponder sensor module further includes a global positioning system, wherein the global positioning system is operable to receive information from one or more satellites and is operable to determine the absolute position of the vehicle mounted module (para [0135]).

As to claim 24, Breed teaches the collision avoidance system of claim 20 wherein each vehicle mounted module is operable to utilize information generated by the global positioning system, the ultra wideband unit and the central tracking unit to determine whether one or more vehicle separation criteria are violated, and generate a warning if one or more vehicle separation criteria are violated (para [0214], [0272]).

(PLEASE SEE NEXT SUPPLEMENTAL BOX)

Supplemental Box

In case **the space in any of the preceding boxes is not sufficient.**

Continuation of:
Box V.2 - Citations and explanations:

Claims 11-12 and 14 lack an inventive step under PCT Article 33(3) as being obvious over Breed in view of US 2006/0025897 A1 to Shostak et al. (hereinafter 'Shostak').

As to claim 11, Breed teaches the rail line vehicle of claim 1 but fails to explicitly teach such a vehicle wherein the vehicle mounted modules comprises an additional ultra wideband unit, wherein an offset exists between the ultra wideband unit and the additional ultra wideband unit once the two units are mounted on the rail line vehicle. However, Shostak teaches such a vehicle wherein the vehicle mounted modules comprises an additional ultra wideband unit, wherein an offset exists between the ultra wideband unit and the additional ultra wideband unit once the two units are mounted on the rail line vehicle ("Another method is to offset the antenna array, as illustrated in FIG. 21, so that the returns naturally are spaced in time," para [0916]). It would have been obvious to one of ordinary skill in the art to combine the rail line vehicle system of Breed with the support for wideband offsets of Shostak, because Breed and Shostak are directed to systems and methods for ultra wideband transponders used for vehicle sensors. Furthermore, users benefit from systems and methods adapted for wideband offsets, because such systems and methods allow for naturally spacing signals from ultra wideband transponders in time (para [0916]).

As to claim 12, Breed teaches the rail line vehicle of claim 1 but fails to explicitly teach such a vehicle wherein the ultra wideband unit is adapted to transmit and receive signals with varying center frequencies. However, Shostak teaches such a vehicle wherein the ultra wideband unit is adapted to transmit and receive signals with varying center frequencies ("the center frequency of the UWB transceiver could be hopped or swept simultaneously," para [0979]). It would have been obvious to one of ordinary skill in the art to combine the rail line vehicle system of Breed with the support for varying center frequencies of Shostak, because Breed and Shostak are directed to systems and methods for ultra wideband transponders used for vehicle sensors. Furthermore, users benefit from systems and methods adapted for varying center frequencies, because such systems and methods allow for multiple antennas (para [0979]-[0980]).

As to claim 14, Breed teaches the rail line vehicle of claim 1 but fails to explicitly teach such a vehicle wherein the user interface is a touchscreen including a screen, the touchscreen being operable to display one or more screens, menus, options and/or functions, and accept user input from the vehicle operator by allowing the vehicle operator to touch the screen of the touchscreen. However, Shostak teaches such a vehicle wherein the user interface is a touchscreen including a screen, the touchscreen being operable to display one or more screens, menus, options and/or functions, and accept user input from the vehicle operator by allowing the vehicle operator to touch the screen of the touchscreen (para [1555]). It would have been obvious to one of ordinary skill in the art to combine the rail line vehicle system of Breed with the support for touchscreens of Shostak, because Breed and Shostak are directed to systems and methods for interfaces used with vehicle sensors. Furthermore, users benefit from systems and methods adapted for touchscreens, because such systems and methods allow for touch interfaces for a wide variety of sensors (para [1555]).

Claims 15-16 lack an inventive step under PCT Article 33(3) as being obvious over Breed in view of US 2010/0207787 A1 to Catten et al. (hereinafter 'Catten').

As to claim 15, Breed teaches the rail line vehicle of claim 1 but fails to explicitly teach such a vehicle wherein the vehicle mounted module is operable to utilize a progressive warning feature that generates a warning if one or more vehicle separation thresholds are violated, wherein the rate, frequency, prominence and/or severity of the warning increases as the violation of the vehicle separation threshold becomes more critical. However, Catten teaches such a vehicle wherein the vehicle mounted module is operable to utilize a progressive warning feature that generates a warning if one or more vehicle separation thresholds are violated, wherein the rate, frequency, prominence and/or severity of the warning increases as the violation of the vehicle separation threshold becomes more critical ("the vehicle monitoring system may present single or multiple warnings or alerts to the driver both in increasing frequency and/or pitch, and/or light intensity," para [0050]). It would have been obvious to one of ordinary skill in the art to combine the rail line vehicle system of Breed with the support for increasing alert frequency of Catten, because Breed and Catten are directed to systems and methods for proximity alerts using vehicle sensors. Furthermore, users benefit from systems and methods adapted for increasing alert frequency, because such systems and methods allow for providing a changing alert to a driver based on travel conditions (para [0050]).

As to claim 16, Catten teaches the rail line vehicle of claim 15 wherein the progressive warning feature utilizes an adaptive threshold feature that modifies the one or more vehicle separation thresholds based on the speed of the rail line vehicle and the speed of one or more nearby vehicles ("the parameters used to evaluate driver behavior may be modified based upon road conditions. Additionally, the driver may be evaluated based upon his reaction to changes in road conditions and his response to warnings of changing road conditions. The monitoring levels that are set in the vehicle monitoring system may be configured to be adjusted based upon road conditions," para [0061]).

Claims 1-24 have industrial applicability as defined by PCT Article 33(4), because the subject matter can be made or used in industry.

SEARCH HISTORY

Application Number	PCT/US 12/38332
Search Conducted By	PAH
Search Approved By	PJN

US/IPC Classifications Searched	USPC: 701/301 IPC(8): G06F 17/10 (2012.01)
Date Conducted	02 July 2012 (02.07.2012)

Documentation Searched	USPC: 701/301, 19 (Keyword limited; terms below) IPC(8): G06F 17/10 (2012.01) (Keyword limited; terms below)
Search Terms Used	rail vehicle sensor distance vehicle-mounted transponder ultra wideband between vehicles operator interface tracking unit touchscreen
Date Conducted	02 July 2012 (02.07.2012)

Electronic Database Searched	PubWEST
Files Searched	PGPB, USPT, EPAB, JPAB
Date Conducted	02 July 2012 (02.07.2012)
Search Logic:	

DATE: Monday, July 02, 2012 Purge Queries Printable Copy Create Case

Set Name Side by Side	Query	Hit Count	Set Name Result Set	Set Name Grid
	DB=PGPB,USPT,EPAB,JPAB; PLUR=YES; OP=ADJ			
L70	L33 AND (discret$6 OR separat$6 OR uniq$4) NEAR5 (housing OR casing)	12	L70	L70
L69	L68 AND (discret$6 OR separat$6 OR uniq$4) NEAR5	0	L69	L69

SEARCH HISTORY

	(housing OR casing)			
L68	L33 AND stop$6 NEAR5 distan$6	18	L68	L68
L67	L66 AND stop$6 NEAR5 distan$6	4	L67	L67
L66	L33 AND (adapt$6 OR smart OR intelligent OR dynamic$6 OR adjust$6) NEAR5 (threshold$6 OR toleranc$6)	4	L66	L66
L65	L33 AND adapt$6 NEAR5 (threshold$6 OR toleranc$6)	0	L65	L65
L64	L63 AND adapt$6 NEAR5 (threshold$6 OR toleranc$6)	0	L64	L64
L63	L62 AND (volume OR amplitude OR severity OR frequency OR rate OR prominence) SAME (progress$6 OR rachet$6 OR increas$6 OR gradua$8 OR iterat$8 OR increment$6)	20	L63	L63
L62	L60 AND (progress$6 OR rachet$6 OR increas$6 OR gradua$8 OR iterat$8 OR increment$6) SAME (warn$4 OR alert$4 OR alarm$6 OR beacon OR klaxon OR siren)	20	L62	L62
L61	L60 AND (progress$6 OR rachet$6 OR increas$6 OR gradua$8 OR iterat$8 OR increment$6) NEAR5 (warn$4 OR alert$4 OR alarm$6 OR beacon OR klaxon OR siren)	0	L61	L61
L60	L59 AND (volume OR amplitude OR severity OR frequency OR rate OR prominence) SAME (progress$6 OR rachet$6 OR increas$6 OR gradua$8 OR iterat$8 OR increment$6)	20	L60	L60
L59	L33 AND (threshold$6 OR toleranc$6) SAME (warn$4 OR alert$4 OR alarm$6 OR beacon OR klaxon OR siren)	20	L59	L59
L58	L33 AND (progress$6 OR rachet$6 OR increas$6 OR gradua$8 OR iterat$8 OR increment$6) NEAR5 (warn$4 OR alert$4 OR alarm$6 OR beacon OR klaxon OR siren)	2	L58	L58
L57	L56 AND (progress$6 OR rachet$6 OR increas$6 OR gradua$8 OR iterat$8 OR increment$6) NEAR5 (warn$4 OR alert$4 OR alarm$6 OR beacon OR klaxon OR siren)	0	L57	L57
L56	L55 AND (touchscreen OR ((touch OR multitouch OR multi-touch) ADJ (screen OR display)) OR ((touch OR multitouch OR multi-touch) NEAR3 (screen OR display)))	33	L56	L56
L55	L54 AND (laser OR radar OR infrared OR IR)	33	L55	L55
L54	L53 AND (vary$6 OR dynamic$6 OR differ$6 OR multip$6)	33	L54	L54
L53	L33 AND ((center OR central) NEAR freq$8)	33	L53	L53
L52	L33 AND (vary$6 OR dynamic$6 OR differ$6 OR multip$6) SAME ((center OR central) NEAR freq$8)	0	L52	L52
L51	L50 AND (vary$6 OR dynamic$6 OR differ$6 OR multip$6) SAME ((center OR central) NEAR freq$8)	0	L51	L51
L50	L33 AND offset$6	49	L50	L50
L49	L33 AND (multipl$6 OR many OR several OR "more than	18	L49	L49

SEARCH HISTORY

	one" OR plural$6 OR additional) SAME ("ultra wideband" OR ultra-wideband OR "ultra-wide band" OR uwb OR (ultra ADJ wide ADJ band))			
L48	L47 AND (multipl$6 OR many OR several OR "more than one" OR plural$6 OR additional) SAME ("ultra wideband" OR ultra-wideband OR "ultra-wide band" OR uwb OR (ultra ADJ wide ADJ band))	0	L48	L48
L47	L46 AND (multipl$6 OR many OR several OR "more than one" OR plural$6 OR additional) SAME (transpond$8 OR sensor$4)	5	L47	L47
L46	L33 AND calibrat$8 SAME length	5	L46	L46
L45	L33 AND calibrat$8 SAME length SAME (location OR distance OR placement)	0	L45	L45
L44	L43 AND calibrat$8 SAME length SAME (location OR distance OR placement)	0	L44	L44
L43	L42 AND ((detect$6 OR measur$6 OR calcul$8) NEAR (inertia$4))	12	L43	L43
L42	L41 AND ((speedometer OR tachometer) OR ((detect$6 OR measur$6 OR calcul$8) NEAR (speed OR velocity)))	12	L42	L42
L41	L40 AND (interface OR ui OR gui) SAME (config$6 OR calibrat$6 OR servic$6 OR fix OR maintenanc$6 OR maintain$4 OR diagnos$6 OR updat$6 OR install$6)	12	L41	L41
L40	L33 AND (violat$6 OR exceed$6) NEAR5 (criteri$4 OR toleranc$4 OR threshold$4)	24	L40	L40
L39	L38 AND (violat$6 OR exceed$6) NEAR5 (criteri$4 OR toleranc$4 OR threshold$4)	12	L39	L39
L38	L37 AND (((absolute OR geograph$8) NEAR5 (position$6 OR locat$6)) OR (latitud$6 AND longitud$6))	19	L38	L38
L37	L36 AND (gps OR (global NEAR position$6))	36	L37	L37
L36	L35 AND (track$6 OR monitor$6) NEAR5 (position$4 OR locat$6)	37	L36	L36
L35	L34 AND central$6 SAME ((tracking OR monitor$6) NEAR5 (unit OR device OR sensor))	37	L35	L35
L34	L33 AND (tracking OR monitor$6) NEAR5 (unit OR device OR sensor)	51	L34	L34
L33	L32 AND (input$6 OR entry)	51	L33	L33
L32	L31 AND (vehic$6 OR transport$8 OR train OR car) NEAR5 (operator OR driver OR pilot OR conductor OR engineer)	51	L32	L32
L31	L30 AND (interface OR ui OR gui)	51	L31	L31
L30	L29 AND (processor OR cpu)	100	L30	L30
L29	L28 AND ((control$6 OR manag$6) NEAR5 (electronic$6 OR circuit$4 OR comput$6 OR devic$6))	100	L29	L29

SEARCH HISTORY

L28	L27 AND (recei$6 OR download$4) NEAR5 (data OR info$8)	100	L28	L28
L27	L26 AND (send$4 OR transmi$6 OR upload$6) NEAR5 (data OR info$8)	100	L27	L27
L26	L25 AND between NEAR5 (vehic$6 OR transport$8 OR train OR car)	100	L26	L26
L25	L24 AND ((measur$8 OR calc$8 OR detect$6) NEAR5 (distance OR space))	100	L25	L25
L24	L23 AND ("ultra wideband" OR ultra-wideband OR "ultra-wide band" OR uwb OR (ultra ADJ wide ADJ band))	103	L24	L24
L23	L22 AND (vehic$6 OR transport$8 OR train OR car) NEAR5 (mount$6 OR attach$6 OR affix$4 OR fixed)	708	L23	L23
L22	L21 AND transpond$8	1307	L22	L22
L21	((rail$6 OR "rail line") NEAR3 (vehic$6 OR transport$8 OR train OR car))	76765	L21	L21
L20	L18 AND (track$6 OR monitor$6) NEAR5 (position$4 OR locat$6)	7	L20	L20
L19	L18 AND central$6 SAME ((tracking OR monitor$6) NEAR5 (unit OR device OR sensor))	0	L19	L19
L18	L17 AND (tracking OR monitor$6) NEAR5 (unit OR device OR sensor)	7	L18	L18
L17	L16 AND (input$6 OR entry)	7	L17	L17
L16	L15 AND (vehic$6 OR transport$8 OR train OR car) NEAR5 (operator OR driver OR pilot OR conductor OR engineer)	7	L16	L16
L15	L14 AND (interface OR ui OR gui)	7	L15	L15
L14	L13 AND (processor OR cpu)	20	L14	L14
L13	L12 AND ((control$6 OR manag$6) NEAR5 (electronic$6 OR circuit$4 OR comput$6 OR devic$6))	20	L13	L13
L12	L11 AND (recei$6 OR download$4) NEAR5 (data OR info$8)	20	L12	L12
L11	L10 AND (send$4 OR transmi$6 OR upload$6) NEAR5 (data OR info$8)	20	L11	L11
L10	L9 AND between NEAR5 (vehic$6 OR transport$8 OR train OR car)	20	L10	L10
L9	L8 AND ((measur$8 OR calc$8 OR detect$6) NEAR5 (distance OR space))	20	L9	L9
L8	L7 AND ("ultra wideband" OR ultra-wideband OR "ultra-wide band" OR uwb OR (ultra ADJ wide ADJ band))	20	L8	L8
L7	L6 AND (vehic$6 OR transport$8 OR train OR car) NEAR5 (mount$6 OR attach$6 OR affix$4 OR fixed)	97	L7	L7
L6	L5 AND transpond$8	127	L6	L6

SEARCH HISTORY

L5	L4 AND ((rail$6 OR "rail line") NEAR3 (vehic$6 OR transport$8 OR train OR car))	791	L5	L5
L4	L1 OR L2 OR L3	6787	L4	L4
L3	(701/19).ccls.	973	L3	L3
L2	(G06F17/10).ipc.	3346	L2	L2
L1	(701/301).ccls.	2601	L1	L1

END OF SEARCH HISTORY

Electronic Database Searched	Google
Files Searched	Google Scholar
Date Conducted	02 July 2012 (02.07.2012)
Search Logic:	
rail vehicle sensor distance vehicle-mounted transponder ultra wideband between vehicles operator interface tracking unit touchscreen - 2 results (0.06 sec)	

Electronic Database Searched	Google
Files Searched	Google Patents
Date Conducted	02 July 2012 (02.07.2012)
Search Logic:	
rail vehicle sensor distance vehicle mounted transponder between vehicles operator interface - 1 result (0.30 seconds)	

Electronic Database Searched	Google
Files Searched	Google Web
Date Conducted	02 July 2012 (02.07.2012)
Search Logic:	
rail vehicle sensor distance vehicle-mounted transponder ultra wideband between vehicles operator interface tracking unit touchscreen - About 17,500 results (0.68 seconds)	

Supplemental Search:

SEARCH HISTORY

DATE: Wednesday, July 04, 2012 Purge Queries Printable Copy Create Case

Set Name Side by Side	Query	Hit Count	Set Name Result Set	Set Name Grid
DB=PGPB,USPT,USOC,EPAB,JPAB; PLUR=YES; OP=OR				
L12	L11 and distance	28	L12	L12
L11	L10 and wideband	29	L11	L11
L10	L9 and rail$4	247	L10	L10
L9	(701/301)![CCLS]	2625	L9	L9

END OF SEARCH HISTORY

Electronic Acknowledgement Receipt

EFS ID:	13723651
Application Number:	13474428
International Application Number:	
Confirmation Number:	6724
Title of Invention:	COLLISION AVOIDANCE SYSTEM FOR RAIL LINE VEHICLES
First Named Inventor/Applicant Name:	Richard C. Carlson
Customer Number:	23446
Filer:	Jeb Anthony Shookman/Julia Villarreal
Filer Authorized By:	Jeb Anthony Shookman
Attorney Docket Number:	24983US02
Receipt Date:	12-SEP-2012
Filing Date:	17-MAY-2012
Time Stamp:	15:20:01
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal Letter	24983US02_IDS_Transmittal_Filed_9_12_2012.pdf	17851 956de431237ebb6fc006f8cc86a28c649b02aa6a	no	2

Warnings:	
Information:	

2	Information Disclosure Statement (IDS) Form (SB08)	24983US02_IDS_SB08a_EFS_Filed_9_12_2012.pdf	612335 c3d006584c010df45d53b9350bb65f628ddffa50	no	4

Warnings:

Information:

A U.S. Patent Number Citation or a U.S. Publication Number Citation is required in the Information Disclosure Statement (IDS) form for autoloading of data into USPTO systems. You may remove the form to add the required data in order to correct the Informational Message if you are citing U.S. References. If you chose not to include U.S. References, the image of the form will be processed and be made available within the Image File Wrapper (IFW) system. However, no data will be extracted from this form. Any additional data such as Foreign Patent Documents or Non Patent Literature will be manually reviewed and keyed into USPTO systems.

3	Non Patent Literature	01NPL_ISR_and_Written_Opinion.pdf	1844245 b90974e272d948fd6b15410b2956d9e07d09e4b7	no	13

Warnings:

Information:

Total Files Size (in bytes):	2474431

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
(Our Case No. 24983US02)

In The Application Of:	
Richard C. Carlson	
Serial No.:	13/474,428
Filed:	May 17, 2012
For:	COLLISION AVOIDANCE SYSTEM FOR RAIL LINE VEHICLES
Examiner:	Not Assigned
Group Art Unit:	Not Assigned
Confirmation No.:	6724
Customer No.	23446

CERTIFICATE OF TRANSMISSION

I hereby certify that this correspondence is being transmitted via EFS-Web to the United States Patent and Trademark Office on September 12, 2012.

By: / Jeb A. Shookman /
Jeb A. Shookman
Reg. No.: 67.793

TRANSMITTAL OF SUPPLEMENTAL INFORMATION DISCLOSURE STATEMENT

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

ATTACHMENTS

Attached are the following:

A completed PTO/SB/08A which has four (4) pages.

A copy of each foreign and non-patent literature reference listed in the attached form PTO/SB/08A and not previously provided to or by the PTO in this application.

FEE DETERMINATION

Applicants believe that no fee is due since this Information Disclosure Statement is being filed before receipt of the first Office Action.

However, the Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment, to Deposit Account No. 13-0017, in the name of McAndrews, Held & Malloy.

REQUEST FOR CONSIDERATION

This paper and enclosures are believed to be entitled to consideration under 37 C.F.R. § 1.97, based on the facts stated above.

This submission is in no way intended as an admission that the cited references constitute prior art under any subsection of 35 U.S.C. § 102 or §103. Applicant expressly retains the right to argue that any of the cited references are not indeed prior art or to take any actions necessary to remove any of the cited references from the available prior art.

The Examiner is requested to initial a copy of the attached PTO/SB/08A and return it to the Applicant to indicate consideration of the cited references.

Respectfully submitted,

Dated: September 12, 2012

/Jeb A. Shookman/
Jeb A. Shookman
Reg. No. 67,793

McAndrews, Held & Malloy, Ltd.
500 West Madison St., 34th Floor
Chicago, IL 60661
(312) 775-8000

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
13/474,428	05/17/2012	Richard C. Carlson	24983US02

CONFIRMATION NO. 6724

23446
MCANDREWS HELD & MALLOY, LTD
500 WEST MADISON STREET
SUITE 3400
CHICAGO, IL 60661

PUBLICATION NOTICE

OC00000057758637

Title:COLLISION AVOIDANCE SYSTEM FOR RAIL LINE VEHICLES

Publication No.US-2012-0296562-A1
Publication Date:11/22/2012

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently http://www.uspto.gov/patft/.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Office of Public Records. The Office of Public Records can be reached by telephone at (703) 308-9726 or (800) 972-6382, by facsimile at (703) 305-8759, by mail addressed to the United States Patent and Trademark Office, Office of Public Records, Alexandria, VA 22313-1450 or via the Internet.

In addition, information on the status of the application, including the mailing date of Office actions and the dates of receipt of correspondence filed in the Office, may also be accessed via the Internet through the Patent Electronic Business Center at www.uspto.gov using the public side of the Patent Application Information and Retrieval (PAIR) system. The direct link to access this status information is currently http://pair.uspto.gov/. Prior to publication, such status information is confidential and may only be obtained by applicant using the private side of PAIR.

Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

Office of Data Managment, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/474,428	05/17/2012	Richard C. Carlson	24983US02	6724

23446 7590 08/02/2013

MCANDREWS HELD & MALLOY, LTD
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CHICAGO, IL 60661

EXAMINER	
PAYNE, ROBERT T	

ART UNIT	PAPER NUMBER
3662	

NOTIFICATION DATE	DELIVERY MODE
08/02/2013	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

mhmpto@mcandrews-ip.com

Office Action Summary	Application No. 13/474,428	Applicant(s) CARLSON ET AL.	
	Examiner ROBERT PAYNE	Art Unit 3662	AIA (First Inventor to File) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *17 May 2012*.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

5)☒ Claim(s) *1-24* is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6)☐ Claim(s) _____ is/are allowed.

7)☒ Claim(s) *1-24* is/are rejected.

8)☐ Claim(s) _____ is/are objected to.

9)☐ Claim(s) _____ are subject to restriction and/or election requirement.

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some * c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *May 17, 2012 and September 12, 2012*.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

4) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of pre-AIA 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

1. Claims 1-10, 13, and 17-24 stand rejected under 35 USC § 102b as being anticipated by US 2008/0150786 A1 to Breed.

2. Concerning claim 1, Breed teaches a rail line vehicle having a vehicle mounted module, the vehicle mounted module comprising a transponder sensor module including an ultra-wideband unit and a wireless communications antenna, wherein the ultra-wideband unit is operable to detect a distance between the rail line vehicle and at least one other vehicle, wherein the wireless communications antenna is operable to send and receive data over the air ("Vehicle 18 contains two receivers 160,161 for the micro power impulse radar (MIR) implementation of the invention. MIR or ultra-wideband (UWB) transmitter devices are placed at locations 151,152 and 153 respectively," Para [0183]); a control electronics module including a processor that is in communication with at least the ultra-wideband unit ("A vehicle 246 includes an antenna 248 coupled to a control module, control unit, processor or computer 250. The antenna, which can be an imager, 248 receives transmissions (waves or wireless signals) including transmissions 252 when in range of the transmitters," Para [0213]); and a user interface module including a user interface, wherein the user interface is operable to provide a vehicle operator with information and is operable to accept input from the vehicle operator ("a user input device on the vehicle which enables an occupant of the vehicle to request information to be transmitted via the transmitter," Para [0366]).

3. Concerning claim 2, Breed teaches the rail line vehicle of claim 1 wherein the vehicle mounted module is in communication with one or more central tracking units by way of the wireless communications antenna, wherein the one or more central tracking units are operable to

track the location of the rail line vehicle and at least one other vehicle ("communications with precise positioning stations for GPS independent location determination," Para [0368]).

4. Concerning claim 3, Breed teaches the rail line vehicle of claim 1 wherein the vehicle mounted module further comprises a central tracking unit module that is operable to track the location of at least one other vehicle (" management of the database may include transmitting from the vehicle requests, for example, to other vehicles, a central map management facility or infrastructure, to ascertain whether the database has current map data for the current location of the vehicle and surrounding locations," Para [0155); "-the system described herein also ~emits better simultaneous tracking of several vehicles," Para [0309]).

5. Concerning claim 4, Breed teaches the rail line vehicle of claim 1 wherein the transponder sensor module further includes a global positioning system, wherein the global positioning system is operable to receive information from one or more satellites and is operable to determine the absolute position of the rail line vehicle ("initially, it is preferred to use the GPS navigational satellites as the base technology," Para [0159]).

6. Concerning claim 5, Breed teaches the rail line vehicle of claim 4 wherein the vehicle mounted module is operable to utilize information generated by the global positioning system and the ultra-wideband unit to determine whether one or more vehicle separation criteria are violated, and generate a waning if one or more vehicle separation criteria are violated ("the extraction of information from radio frequency wave transmission may be limited based on a threshold determination (a filter of sorts) Concerning whether the transmission is of potential 'interest, e.g., to the operation of the vehicle based on its position, location and/or motion," Para [0214]; "Other reactive systems 265 are also envisioned, e.g., a warning system to warn the driver of the vehicle about the presence of another vehicle within a threshold distance from the vehicle," Para [0272]).

7. Concerning claim 6, Breed teaches the rail line vehicle of claim 1 wherein the user interface module further includes a service interface operable to allow the vehicle operator to configure, calibrate, service, maintain, diagnose, update and/or install information on vehicle mounted module ("calibration system," Para [0200]; "the diagnostic or prognostic determination is transmitted from the vehicle to a transmitter which in turn can direct the determination to a

dealer, manufacturer, vehicle owner and/or service center," Para [0368]; "diagnostic and prognostic telematics communications," Para [0397]).

8. Concerning claim 7, Breed teaches the rail line vehicle of claim 1 wherein the control electronics module further includes one or more interfaces that are operable to communicate with ground speed detection modules ("ground speed monitoring system using lasers, radar or ultrasonics," Para [0502]).

9. Concerning claim 8, Breed teaches the rail line vehicle of claim 7 wherein the ground speed detection modules include one or more of microwave radar, a laser device, an infrared sensor and an ultra-wideband sensor (Para [0502]).

10. Concerning claim 9, Breed teaches the rail line vehicle of claim 1 wherein the control electronics module further includes one or more inertial measurement units ("The inertial navigation system (INS), sometimes celled the inertial reference unit or IRU, comprises one or more accelerometers 78 and one or more gyroscopes," Para [0503]).

11. Concerning claim 10, Breed teaches the rail line vehicle of claim 1 wherein the vehicle mounted modules comprises one or more additional transponder sensor modules, wherein the vehicle mounted module is operable to accept calibration information regarding the length of the rail line vehicle and the mounting locations of the transponder sensor module and the one or more additional transponder sensor modules ("Extension assembly 214 can include a mounting bracket 216 from the roof of the vehicle 200 to each data acquisition module 210, a mounting bracket 218 extending from the front bumper upward to each data acquisition module 202 and a cross mounting bracket 220 extending between the data acquisition modules 202 for support. Since all of the data acquisition equipment is co-located, its precise location is accurately determined by the IMU, the mounting location on the vehicle and the differential GPS system," pare [0139]).

12. Concerning claim 13, Breed teaches the rail line vehicle of claim 1 wherein the transponder sensor module further includes one or more of a laser device, a radar sensor and an infrared sensor (Para [0502]).

13. Concerning claim 17, Breed teaches the rail line vehicle of claim 1 wherein the vehicle mounted module is operable to utilize a stopping distance calibration feature that measures a stopping distance, wherein the stopping distance indicates how quickly the rail line vehicle can

stop under current conditions ("Range-gating on the imaging system or reflection measurements on the laser radar units can be used to measure the driver's sight distance and the speed of the vehicle can then be limited to a speed that allows for a safe stopping distance between the vehicle and another vehicle or object that may be in the path of the vehicle or on a collision path with the vehicle," Para [0272]).

14. Concerning claim 18, Breed teaches the rail line vehicle of claim 17 wherein the measured stopping distance is used to modify one or more safe separation distance thresholds ("if a faster moving vehicle approaches a slower moving vehicle, it will automatically slow down to keep a safe separation distance from the leading, slower moving vehicle," Para [0078]).

15. Concerning claim 19, Breed teaches the rail line vehicle of claim 1 wherein the control electronics module further includes an inertial measurement unit (Para [0503]).

16. Concerning claim 20, Breed teaches a collision avoidance system comprising: one or more vehicle mounted modules, each mounted on a vehicle, each vehicle mounted module comprising: a transponder sensor module including an ultra-wideband unit and a wireless communications antenna, wherein the ultra-wideband unit is operable to detect a distance between the vehicle on which the vehicle mounted module is mounted and at least one other vehicle, wherein the wireless communications antenna is operable to send and receive data over the air (Para [0183]); a control electronics module including a processor that is in communication with at least the ultra-wideband unit (Para [0213]); and a user interface module including a user interface, wherein the user interface is operable to provide a vehicle operator with information and is operable to accept input from the vehicle operator (Para [0366]); and a central tracking unit that is in communication with the one or more vehicle mounted modules, the central tracking unit being operable to track the location of the one or more vehicle mounted modules (Para [0368]).

17. Concerning claim 21, Breed teaches the collision avoidance system of claim 20 wherein the central tracking unit is distributed among the one or more vehicle mounted modules, wherein each of the one or more vehicle-mounted modules includes a central tracking unit component, each central tracking unit component is in communication with the vehicle's control electronics module (Para [0135], [0139]).

18. Concerning claim 22, Breed teaches the collision avoidance system of claim 20 wherein the central tracking units disposed in a discrete housing ('Such a device typically has three accelerometers and three gyroscopes that are held together in a single housing," Para [0114]). Concerning claim 23, Breed teaches the collision avoidance system of claim 20 wherein the transponder sensor module further includes a global positioning system, wherein the global positioning system is operable to receive information from one or more satellites and is operable to determine the absolute position of the vehicle mounted module (Para [0135]). Concerning claim 24, Breed teaches the collision avoidance system of claim 20 wherein each vehicle mounted module is operable to utilize information generated by the global positioning system, the ultra-wideband unit and the central tracking unit to determine whether one or more vehicle separation criteria are violated, and generate a warning if one or more vehicle separation criteria are violated (Para [0214], [0272]).

Claim Rejections - 35 USC § 103

16. The following is a quotation of pre-AIA 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

17. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under pre-AIA 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.

2. Ascertaining the differences between the prior art and the claims at issue.

3. Resolving the level of ordinary skill in the pertinent art.

4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

19. Claims 11-12 and 14 stand rejected under 35 USC § 103(a) as being obvious over Breed in view of US 2006/0025897 A1 to Shostak et al. (hereinafter 'Shostak').

20. Concerning claim 11, Breed teaches the rail line vehicle of claim 1 but fails to explicitly teach such a vehicle wherein the vehicle mounted modules comprises an additional ultra-wideband unit, wherein an offset exists between the ultra-wideband unit and the additional ultra-wideband unit once the two units are mounted on the rail line vehicle. However, Shostak teaches such a vehicle wherein the vehicle mounted modules comprises an additional ultra-wideband unit, wherein an offset exists between the ultra-wideband unit and the additional ultra-wideband unit once the two units are mounted on the rail line vehicle ("Another method is to offset the antenna array, as illustrated in FIG. 21, so that the returns naturally are spaced in time," Para [0916]). It would have been obvious to one of ordinary skill in the art to combine the rail line vehicle system of Breed with the support for wideband offsets of Shostak, because Breed and Shostak are directed to systems and methods for ultra-wideband transponders used for vehicle sensors. Furthermore, users benefit from systems and methods adapted for wideband offsets, because such systems and methods allow for naturally spacing signals from ultra-wideband transponders in time (Para [0916]).

21. Concerning claim 12, Breed teaches the rail line vehicle of claim 1 but fails to explicitly teach such a vehicle wherein the ultra-wideband unit is adapted to transmit and receive signals with varying center frequencies. However, Shostak teaches such a vehicle wherein the ultra-wideband unit is adapted to transmit and receive signals with varying center frequencies ("the center frequency of the UWB transceiver could be hopped or swept simultaneously," Para [0979]). It would have been obvious to one of ordinary skill in the art to combine the rail line vehicle system of Breed with the support for varying center frequencies of Shostak, because Breed and Shostak are directed to systems and methods for ultra-wideband transponders used for vehicle sensors. Furthermore, users benefit from systems and methods adapted for varying center frequencies, because such systems and methods allow for multiple antennas (Para [0979]-[0980]).

22. Concerning claim 14, Breed teaches the rail line vehicle of claim 1 but fails to explicitly teach such a vehicle wherein the user interface is a touchscreen including a screen, the touchscreen being operable to display one or more screens, menus, options and/or functions, and accept user input from the vehicle operator by allowing the vehicle operator to touch the screen of the touchscreen. However, Shostak teaches such a vehicle wherein the user interface is a touchscreen including a screen, the touchscreen being operable to display one or more screens, menus, options and/or functions, and accept user input from the vehicle operator by allowing the vehicle operator to touch the screen of the touchscreen (Para [1555]). It would have been obvious to one of ordinary skill in the art to combine the rail line vehicle system of Breed with the support for touchscreens of Shostak, because Breed and Shostak are directed to systems and methods for interfaces used with vehicle sensors. Furthermore, users benefit from systems and methods adapted for touchscreens, because such systems and methods allow for touch interfaces for a wide variety of sensors (Para [1555]).

23. Claims 15-16 stand rejected under 35 USC § 103(a) as being obvious over Breed in view of US 2010/0207787 A1 to Catten et al. (hereinafter 'Catten').

24. Concerning claim 15, Breed teaches the rail line vehicle of claim 1 but fails to explicitly teach such a vehicle wherein the vehicle mounted module is operable to utilize a progressive warning feature that generates a warning if one or more vehicle separation thresholds are violated, wherein the rate, frequency, prominence and/or severity of the warning increases as the violation of the vehicle separation threshold becomes more critical. However, Catten teaches such a vehicle wherein the vehicle mounted module is operable to utilize a progressive warning feature that generates a warning if one or more vehicle separation thresholds are violated, wherein the rate, frequency, prominence and/or severity of the warning increases as the violation of the vehicle separation threshold becomes more critical ("the vehicle monitoring system may present single or multiple warnings or alerts to the driver both in increasing frequency and/or pitch, and/or light intensity," Para [0050]). It would have been obvious to one of ordinary skill in the art to combine the fail'line vehicle system of Breed with the support for increasing alert frequency of Catten, because Breed and Catten are directed to systems and methods for proximity alerts using vehicle sensors. Furthermore, users benefit from systems and methods

adapted for increasing alert frequency, because such systems and methods allow for providing a changing alert to a driver based on travel conditions (Para [0050]).

25. Concerning claim 16, Catten teaches the rail line vehicle of claim 15 wherein the progressive warning feature utilizes an adaptive threshold feature that modifies the one or more vehicle separation thresholds based on the speed of the rail line vehicle and the speed of one or more nearby vehicles ("the parameters used to evaluate driver behavior may be modified based upon road conditions. Additionally, the driver may be evaluated based upon his reaction to changes in road conditions and his response to warnings of changing road conditions. The monitoring levels that are set in the vehicle monitoring system may be configured to be adjusted based upon road conditions," Para [0061]).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to ROBERT PAYNE whose telephone number is (571)272-3241. The examiner can normally be reached on Monday-Thursday from- 8:30 AM-6:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Black can be reached on (571) 272-6956. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

ROBERT PAYNE
Examiner
Art Unit 3662

/Thomas G. Black/
Supervisory Patent Examiner, Art Unit 3661

Notice of References Cited	Application/Control No. 13/474,428	Applicant(s)/Patent Under Reexamination CARLSON ET AL.	
	Examiner ROBERT PAYNE	Art Unit 3662	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-6,295,019 B1	09-2001	Richards et al.	342/125
*	B	US-6,473,028 B1	10-2002	Luc, Wuidart	342/118
*	C	US-2003/0028323 A1	02-2003	Zeitler et al.	701/219
*	D	US-6,674,396 B2	01-2004	Richards et al.	342/125
*	E	US-6,922,166 B2	07-2005	Richards et al.	342/125
*	F	US-7,089,099 B2	08-2006	Shostak et al.	701/29.6
*	G	US-2008/0150786 A1	06-2008	Breed, David S.	342/53
*	H	US-7,725,252 B2	05-2010	Heddebaut et al.	701/408
*	I	US-2010/0207787 A1	08-2010	Catten et al.	340/905
*	J	US-2010/0225527 A1	09-2010	TALTY et al.	342/145
*	K	US-8,231,270 B2	07-2012	Groeneweg et al.	374/141
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
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	S					
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NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
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	V	
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*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	
Filing Date	2012-05-17
First Named Inventor	Richard C. Carlson
Art Unit	TBD
Examiner Name	TBD
Attorney Docket Number	24983US02

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
/R.P./	1	6917284		2005-07-12	Grisham et al.	
/R.P./	2	7148791		2006-12-12	Grisham et al.	

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
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Receipt date: 05/17/2012	Application Number	13474428 - GAU: 3662
INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99**)	Filing Date	2012-05-17
	First Named Inventor	Richard C. Carlson
	Art Unit	TBD
	Examiner Name	TBD
	Attorney Docket Number	24983US02

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1	Time Domain's Ultra Wideband, (UWB), Definition and Advantages, 320-0294A, March 2011, pages. 1-14, Huntsville, Alabama	☐

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[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

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☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

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Signature	/Jeb A. Shookman/	Date (YYYY-MM-DD)	2012-05-17
Name/Print	Jeb A. Shookman	Registration Number	67793

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EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	8945	Trans$4 near20 (wideband or wide-band)	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/07/23 15:12
L2	2016238	(Vehicle or car or bus or van or auto$4 or truck or train) near20 (module or unit or component or element or segment or part or section)	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/07/23 15:13
L3	64243	(colli$4 or hit or strike for crash or bump or RAM or rear-and) near10 (avoid$4 or even a or circumvent or Dodge or sidestep or elude or escape)	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/07/23 15:13
L4	17074	L2 and L3	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/07/23 15:13
L5	178	L4 and L1	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/07/23 15:13
S1	2	"20120296562"	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/07/22 12:20
S2	3	"20080150786"	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/07/22 12:35
S3	9	"1238332"	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/07/22 13:08
S4	3	"20060025897"	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/07/23 09:53
S5	3	"20100207787"	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/07/23 09:54
S6	78	"6295019"	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/07/23 09:55
S7	2	"20030028323"	US-PGPUB; USPAT; FPRS; EPO; JPO;	ADJ	ON	2013/07/23 09:57

			DERWENT			
S8	3	"20060151672"	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/07/23 09:58
S9	3	"20090173839"	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/07/23 09:59
S10	3	"20100225527"	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/07/23 10:00
S11	2016238	(Vehicle or car or bus or van or auto$4 or truck or train) near20 (module or unit or component or element or segment or part or section)	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/07/23 13:09
S12	195	Transponder near20 (wideband)	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/07/23 13:12
S13	44	S11 and S12	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/07/23 13:12
S14	6131	Ultra near10 wideband near10 wireless	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/07/23 13:15
S15	1528	S11 and S14	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/07/23 13:16
S16	205246	(Detect or notice or sense or perceive or distinguish or identify) near10 (distance or space or gap)	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/07/23 13:18
S17	91	S15 and S16	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/07/23 13:18
S18	709957	Between near10 (Vehicle or car or bus or van or auto$4 or truck or train)	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	NEAR	ON	2013/07/23 13:21
S19	428910	S11 and S18	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	NEAR	ON	2013/07/23 13:21
S20	17975	Ultra near10 wideband	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/07/23 13:22
S21	1423	S19 and S20	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/07/23 13:22

S22	356	S21 And S16	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/07/23 13:24
S23	39370	Ultra near10 wideband or wide-Band	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/07/23 13:52
S24	1956	S19 and S23	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/07/23 13:53
S25	226	Transponder near20 (wideband or wide-band)	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/07/23 13:54
S26	5	S24 and S25	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/07/23 13:55
S27	64243	(colli$4 or hit or strike for crash or bump or RAM or rear-and) near10 (avoid$4 or even a or circumvent or Dodge or sidestep or elude or escape)	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/07/23 14:16
S28	17074	S11 and S27	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/07/23 14:17
S29	559	S28 and S23	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/07/23 14:17
S30	373	S29 and S18	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/07/23 14:23
S31	373	S30 and S23	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/07/23 14:23
S32	3	S31 and S25	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/07/23 14:24

EAST Search History (Interference)

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7/23/2013 3:19:46 PM
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Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	13474428	CARLSON ET AL.
	Examiner	**Art Unit**
	ROBERT PAYNE	3662

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	07/23/2013								
	1	✓								
	2	✓								
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	22	✓								
	23	✓								
	24	✓								

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CPC- SEARCHED		
Symbol	Date	Examiner

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner
342	53	7/23/2013	RP
340	905	7/23/2013	RP
342	115	7/23/2013	RP
342	118	7/23/2013	RP
342	125	7/23/2013	RP
701	408	7/23/2013	RP
701	301	7/23/2013	RP
701	29.6	7/23/2013	RP
701	34.3	7/23/2013	RP
701	36	7/23/2013	RP
701	19	7/23/2013	RP
701	34.3	7/23/2013	RP
342	70	7/23/2013	RP
340	905	7/23/2013	RP
701	13	7/23/2013	RP
701	23	7/23/2013	RP
701	4	7/16/2013	RP
701	117	7/16/2013	RP
701	468	7/23/2013	RP
701	409	7/23/2013	RP
701	63	7/23/2013	RP
701	19	7/23/2013	RP
701	28	7/23/2013	RP
701	1	7/23/2013	RP
701	116	7/23/2013	RP
701	500	7/23/2013	RP

US CLASSIFICATION SEARCHED			
Class	**Subclass**	**Date**	**Examiner**
701	2	7/23/2013	RP
701	46	7/23/2013	RP
701	23	7/16/2013	RP

SEARCH NOTES		
Search Notes	**Date**	**Examiner**
Searched East US-PGPUB, USPAT, FPRS, EPO, JPO Derwent	7/23/2013	RP

INTERFERENCE SEARCH			
US Class/ CPC Symbol	**US Subclass / CPC Group**	**Date**	**Examiner**

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed
PTO/SB/08a (01-10)
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First Named Inventor	Richard C. Carlson, et al.
Art Unit	3617
Examiner Name	TBD
Attorney Docket Number	24983US02

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99**)	Filing Date	2012-05-17
	First Named Inventor	Richard C. Carlson, et al.
	Art Unit	3617
	Examiner Name	TBD
	Attorney Docket Number	24983US02

/R.P./	1	International Search Report and Written Opinion of the International Searching Authority, International Application No. PT/US12/38332, International Filing Date May 17, 2012, METROM RAIL, dated July 13, 2012, 24983WO01	☐

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PROPERTY NUMBERS Total: 4

Property Type	Number

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Application Number:	13644737
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Total Attachments: 133
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(54) **CROSSING GATE TIP SENSOR**

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(60) Provisional application No. 61/627,269, filed on Oct. 11, 2011.

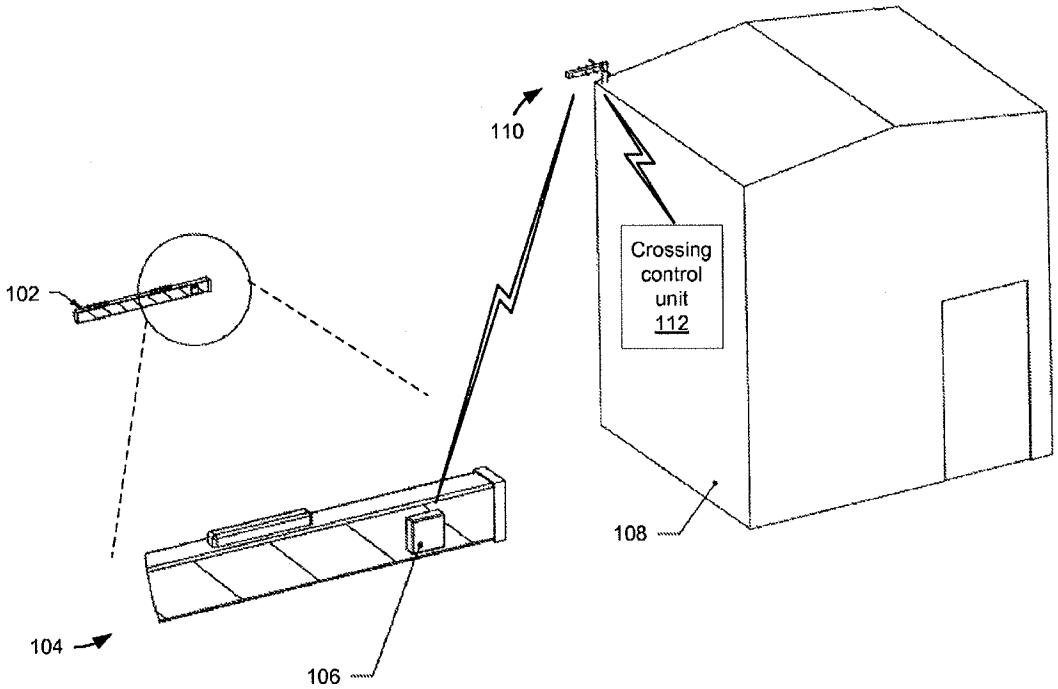
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(57) **ABSTRACT**

Systems, methods, routines and/or techniques for a crossing gate tip sensor are described. According to one or more embodiments of the present disclosure, a crossing gate tip sensor may be attached to or incorporated into a gate arm of a crossing gate. The crossing gate tip sensor may accurately detect the orientation (among other things) of the gate arm. In some embodiments, a crossing gate tip sensor may include a tilt sensor that includes one or more accelerometers. In some embodiments, a crossing gate tip sensor may include a micro-controller and/or a wireless communication unit.



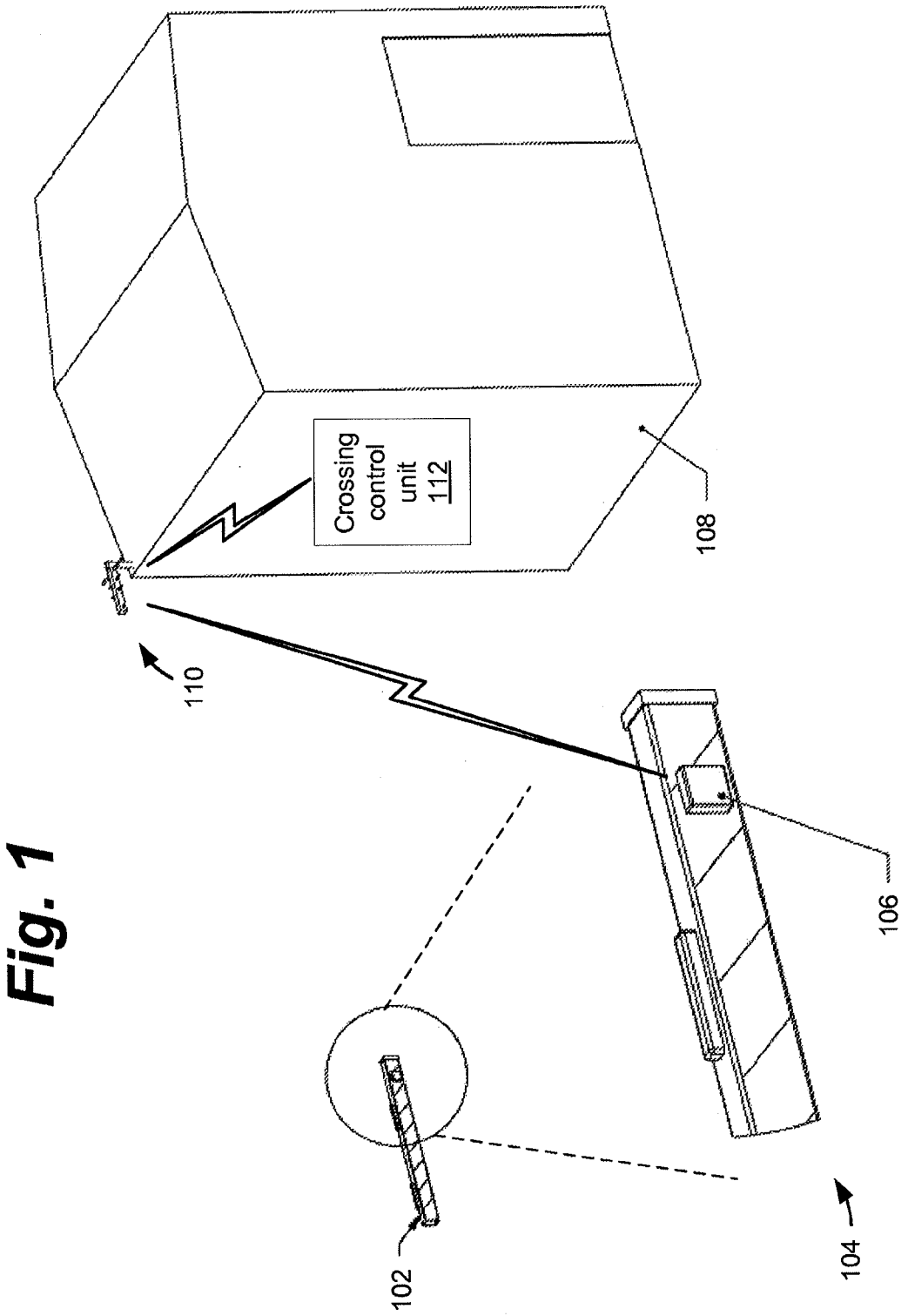


Fig. 1

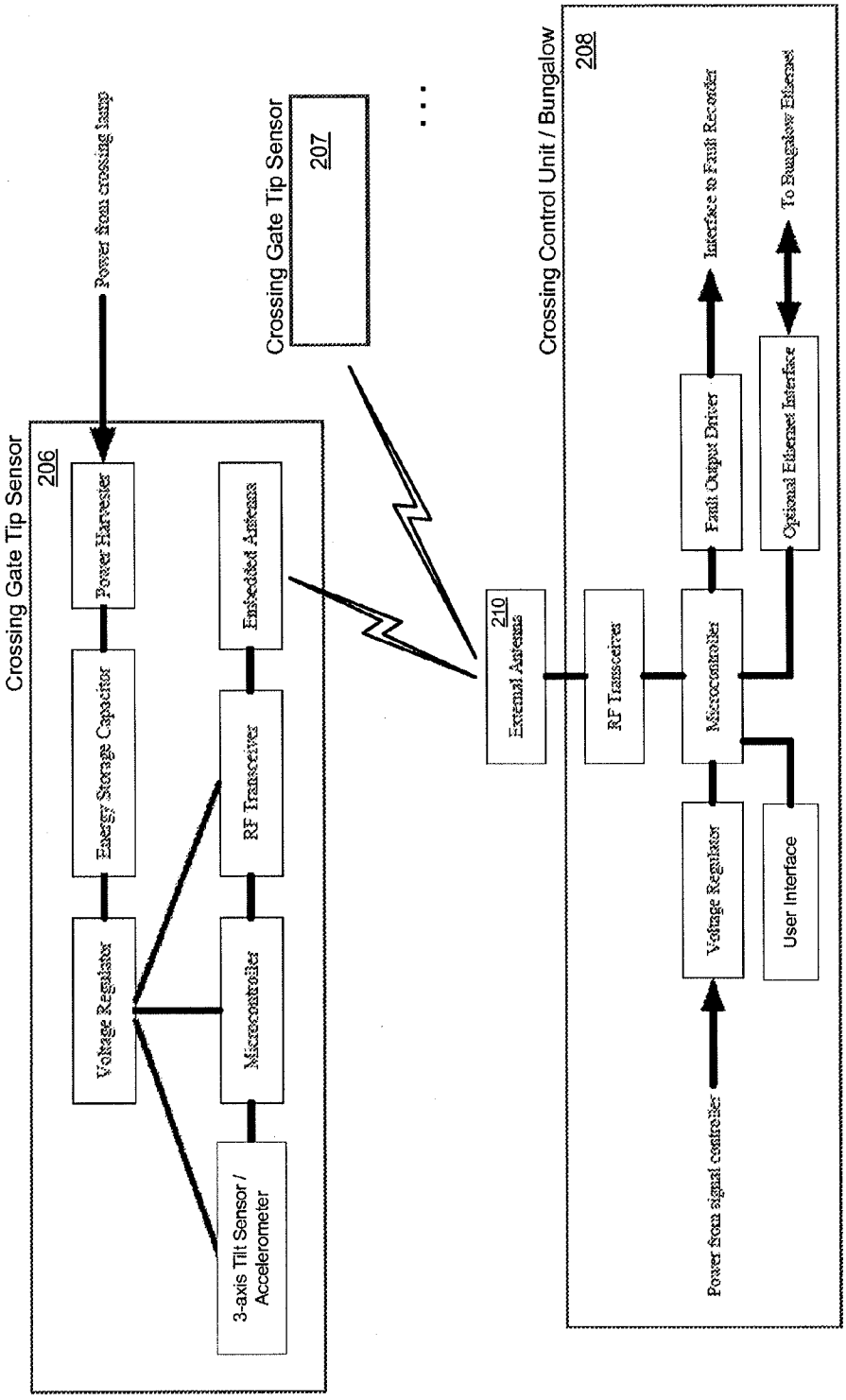

Crossing Gate Tip Sensor
206
Power from crossing lamp
Power Harvester
Energy Storage Capacitor
Voltage Regulator
Embedded Antenna
RF Transceiver
Microcontroller
3-axis Tilt Sensor / Accelerometer
Crossing Gate Tip Sensor
207
. . .
Crossing Control Unit / Bungalow
208
210
External Antenna
RF Transceiver
Microcontroller
Voltage Regulator
Power from signal controller
Fault Output Driver
Interface to Fault Recorder
Optional Ethernet Interface
To Bungalow Ethernet
User Interface

Fig. 2

CROSSING GATE TIP SENSOR

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority from the following U.S. Provisional Patent Applications No. 61/627,269 filed on Oct. 11, 2011. The disclosure of the provisional patent application is incorporated by reference herein in its entirety.

FIELD

[0002] The present disclosure relates to crossing gates, for example, at the intersection of a railroad track and a road, and more particularly to one or more systems, methods, routines and/or techniques for a crossing gate tip sensor.

BACKGROUND

[0003] Railroad crossing gates are used to prevent vehicles from crossing a track where a train is expected to pass in the near future. For example, a railroad crossing gate may be installed at a location where a road intersects a railroad track. Some railroad crossing gates include a long gate arm that acts as a barrier to force a vehicle to stop. The gate arm is normally oriented in an upright or vertical position, when no train passing is imminent. When a train approaches an intersection, the gate arm swings or lowers down to a horizontal position.

SUMMARY

[0004] The present disclosure describes one or more systems, methods, routines and/or techniques for a crossing gate tip sensor. According to one or more embodiments of the present disclosure, a crossing gate tip sensor may be attached to or incorporated into a gate arm of a crossing gate. The crossing gate tip sensor may accurately detect the orientation (among other things) of the gate arm. Various descriptions included herein may describe a crossing gate tip sensor incorporated into a crossing gate related to a railroad track, for example, a railroad track upon which trains and other rail line vehicles may pass. It should be understood, however, that the systems, methods, routines and/or techniques of the present disclosure may be applied to various other types of crossing gates, for example, a crossing gate installed at the intersection of two automobile paths.

[0005] These and other advantages, aspects and novel features of the present disclosure, as well as details of an illustrated embodiment thereof, will be more fully understood from the following description and drawings. It is to be understood that the foregoing general descriptions are exemplary and explanatory only and are not restrictive of the disclosure as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] Several features and advantages are described in the following disclosure, in which several embodiments are explained, using the following drawings as examples.

[0007] FIG. **1** depicts an angled-top-view illustration of an example crossing gate tip sensor and related components, according to one or more embodiments of the present disclosure.

[0008] FIG. **2** depicts block diagram of an example setup that includes one or more crossing gate tip sensors and a crossing control unit and/or bungalow, according to one or more embodiments of the present disclosure.

DETAILED DESCRIPTION

[0009] Various crossing gates are designed such that a gate arm swings or lowers down to a horizontal position when a train traveling on a track approaches an intersection (e.g., an intersection perpendicular to the track). In various situations, it may be important that the gate arm swings completely down to a horizontal and straight (e.g., parallel to the track) position or swings completely up to a vertical and straight position. In some situations, rules (e.g., federally mandated rules) may require that gate arms complete the raising process a specific period of time before a train arrives at the intersection, or complete the lowering process a specific period of time after a train leaves the intersection. For various reasons, a particular gate arm may not lower or raise in an appropriate manner, for example, the gate arm (and/or related gate parts) may have been damaged, dislodged or broken, for example, due to a vehicular impact. Various crossing gates have no accurate method to determine when the gate arm is completely lowered or raised, nor do they have a method to determine the timing or status related to the lowering or raising of the gate arm. For various reasons (e.g., federally mandated rules, safety, design restrictions and the like), various crossing gates cannot include additional signal cables. Furthermore, for various reasons, various crossing gates cannot include additional signal cables to connect the gate to a crossing control unit (e.g., included in a "bungalow").

[0010] The present disclosure describes one or more systems, methods, routines and/or techniques for a crossing gate tip sensor. According to one or more embodiments of the present disclosure, a crossing gate tip sensor may be attached to or incorporated into a gate arm of a crossing gate. The crossing gate tip sensor may accurately detect the orientation (among other things) of the gate arm. Various descriptions included herein may describe a crossing gate tip sensor incorporated into a crossing gate related to a railroad track, for example, a railroad track upon which trains and other rail line vehicles may pass. It should be understood, however, that the systems, methods, routines and/or techniques of the present disclosure may be applied to various other types of crossing gates, for example, a crossing gate installed at the intersection of two automobile paths.

[0011] FIG. **1** depicts an angled-top-view illustration of an example crossing gate tip sensor and related components, according to one or more embodiments of the present disclosure. FIG. **1** shows an example crossing gate arm **102**. Crossing gate arm may be part of a crossing gate that may be located at the intersection of a railroad track and a road, for example. FIG. **1** also shows a close-up view **104** of the crossing gate arm **102**. As can be seen in FIG. **1**, a crossing gate tip sensor **106** may be attached, mounted to and/or incorporated into the gate arm **102**. The crossing gate tip sensor **106** may accurately detect the orientation (among other things) of the gate arm **102**. The crossing gate tip sensor **106** may be in communication with a crossing control unit **112** (e.g., included in a bungalow **108**). The crossing control unit **112** may include and/or be in communication with an antenna **110**, for example, an external antenna mounted on the exterior of bungalow **108**. The crossing gate tip sensor **106** may communicate wirelessly with the antenna **110** to, in turn, communicate with the crossing control unit **112**.

[0012] The crossing gate tip sensor **106** may include a tilt sensor, for example, a solid state 3-axis tilt sensor. A tilt sensor may be a component that includes one or more accelerometers and optionally, other sensors. A tilt sensor may

detect various aspects about its orientation, for example, the angle of orientation in various planes (e.g., X-plane, Y-plane, Z-plane) and/or the speed and/or acceleration of the change in angle. A tilt sensor may produce various digital and/or analog signals based on the various orientation conditions it detects. The crossing gate tip sensor **106** may include a gate integrity detection component, for example, that can detect if a gate is broken, damaged or vandalized. A tilt sensor may provide information that may indicate that a gate is broken, damaged or vandalized, but the gate integrity detection component may provide additional information about the integrity of the gate.

[0013] The crossing gate tip sensor **106** may include a wireless communication component to communicate with a crossing control unit/bungalow. For example, a crossing gate tip sensor **106** may include a frequency hopping radio system (e.g., a 900 Mhz radio, transceiver, antenna, etc.). The wireless communication component may adapt the crossing gate tip sensor **106** to communicate with the crossing control unit/bungalow without wired signal cables. The crossing gate tip sensor **106**, via the wireless communication component, may communicate (and/or receive) various pieces of information to the crossing control unit/bungalow, for example, exact gate arm **102** position and/or orientation. As another example, the crossing gate tip sensor **106**, via the wireless communication component, may communicate information about whether a gate is broken, damaged or vandalized. The information communicated to the crossing control unit/bungalow may include various warnings about the integrity and/or operation and/or status and/or orientation of a crossing gate.

[0014] The crossing gate tip sensor **106** may include a power source and/or a power component that is designed to use power from an existing power source. For example, a power source may be a battery or a capacitor. As another example, a power component (e.g., included in the crossing gate tip sensor) may connect to an existing power source of another component of the crossing gate. For example, the power component connect to an existing warning light system wire harness, for example, which may be located on the crossing gate. In some embodiments, a power component (e.g., connected to an existing power source) may charge an internal power source (e.g., a battery and/or a capacitor) in the crossing gate tip sensor.

[0015] The bungalow **108** may include a crossing control unit **112**. The crossing control unit may include various components, modules, circuitry, connections and the like. The crossing control unit **112** may communicate (e.g., via antenna **110**) with one or more crossing gates. The crossing control unit **112** may detect when various crossing gates are oriented in the vertical position or when they are lowered. In some embodiments, the crossing control unit **112** may communicate with various crossing gates to instruct the crossing gates to lower or raise. The crossing control unit **112** may include a user interface. The user interface may allow a user to perform initial setup or calibration of various gates. The user interface may allow a user to see status, warnings and the like related to the integrity, orientation and the like of various gates.

[0016] FIG. **2** depicts block diagram of an example setup that includes one or more crossing gate tip sensors and a crossing control unit and/or bungalow, according to one or more embodiments of the present disclosure. FIG. **2** shows an example crossing gate tip sensor **206**, which may be similar to the crossing gate tip sensor **106** of FIG. **1**, for example. The setup may include a number of other crossing gate tip sensors, for example, crossing gate tip sensor **207**. Crossing gate tip sensor **206** may include various components, sensors, connections and the like. For example, as shown in FIG. **2**, crossing gate tip sensor **206** may include a 3-axis tilt sensor/accelerometer, as explained about with regard to FIG. **1**. Crossing gate tip sensor **206** may include a microcontroller. Crossing gate tip sensor **206** may include various components and/or connections that adapt the crossing gate tip sensor **206** to communicate with a crossing control unit and/or bungalow, for example, an RF transceiver and an antenna (e.g., an embedded antenna). Crossing gate tip sensor **206** may include various components and/or connections that adapt the crossing gate tip sensor **206** to receive and/or store energy to power the various components of the crossing gate tip sensor. For example, crossing gate tip sensor **206** may include a power harvester, for example, to receive power from an existing power source, such as a crossing lamp. Crossing gate tip sensor **206** may include an energy store, for example, a battery or a capacitor (as shown in FIG. **2**). Crossing gate tip sensor **206** may include a voltage regulator that may condition the power from the energy store before passing it to other components of the crossing gate tip sensor **206**.

[0017] FIG. **2** shows an example crossing control unit **208** (e.g., included inside a bungalow). Crossing control unit **208** may include and/or be in communication with an antenna **210** (e.g., an external antenna mounted on a bungalow). Crossing control unit **208** may communicate with one or more crossing gates and/or crossing gate tip sensors (e.g., **206**, **207**) via the antenna **210**. Crossing control unit **208** may include an RF transceiver that pairs with the antenna **210**. As shown in FIG. **2**, crossing control unit **208** may include various other components, sensors, connections and the like. For example, crossing control unit **208** may include a microcontroller. Crossing control unit **208** may include a voltage regulator, for example, to condition power from a signal controller. Crossing control unit **208** may include a user interface, as explained above with regard to FIG. **1**. Crossing control unit **208** may include a fault output driver, for example, to interface with a fault recorder. Crossing control unit **208** may include various communication interfaces, for example, an Ethernet interface that may connect to an Ethernet connection within the bungalow.

[0018] In operation, and referring again to FIG. **1**, a gate tip sensor **106** may communicate with the crossing control unit to send and/or receive information. For example, if it is detected (e.g., by components in the bungalow **108**) that a rail line vehicle is approaching the crossing gate, the crossing control unit **112** may send a signal to the crossing gate that it should raise its gate arm **102**. Alternatively, the detection of an approaching vehicle may occur in or near the crossing gate itself. The crossing gate may proceed to raise the gate arm **102** from a substantially horizontal (lowered) position to a substantially vertical (raised) position. During and/or after the gate arm **102** is lifted, the crossing gate tip sensor **106** may communicate various pieces of information to the crossing control unit. In this respect, the crossing control unit may continuously maintain updated information about the status of the gate arm **102**. After the train passes through and leaves the intersection, the crossing gate may lower its gate arm **102**. During and/or after the gate arm **102** is lowered, the crossing gate tip sensor **106** may communicate various pieces of information to the crossing control unit. In this respect, the crossing control unit may continuously maintain updated information about the status of the gate arm **102**. If at any point the

gate arm is not operating in an appropriate manner, the crossing gate tip sensor may communicate one or more warnings to the crossing control unit **112**. The crossing control unit **112** may then perform various operations based on this information. For example, if the malfunction of the gate arm is serious (e.g., the gate arm is not raising or lowering fully), the crossing control unit **112** may initiate a warning, for example, to warn an approaching rail vehicle or automobile. In some situations, the crossing control unit **112** may initiate a message to one or more entities to indicate that a crossing gate may be in need of maintenance.

[0019] The description of the different advantageous embodiments has been presented for purposes of illustration and the description and is not intended to be exhaustive or limited to the embodiments in the form disclosed. Many modifications and variations will be apparent to those of ordinary skill in the art. Further different advantageous embodiments may provide different advantages as compared to other advantageous embodiments. The embodiment or embodiments selected are chosen and described in order to best explain the principles of the embodiments of the practical application and to enable others of ordinary skill in the art to understand the disclosure for various embodiments with various modifications as are suited to the particular use contemplated.

1. A crossing gate tip sensor, comprising a sensor module attached or incorporated into a crossing gate arm, wherein the sensor module includes:

a tilt sensor that includes one or more accelerometers;

a microcontroller; and

a wireless communication unit.

2. The crossing gate tip sensor of claim **1**, wherein the sensor module is adapted to detect the orientation of the crossing gate arm.

3. The crossing gate tip sensor of claim **1**, wherein the sensor module is adapted to detect the orientation of the crossing gate arm in three dimensions or planes.

4. The crossing gate tip sensor of claim **1**, wherein the sensor module is adapted to detect the speed of change of orientation of the crossing gate arm.

5. The crossing gate tip sensor of claim **1**, wherein the sensor module is adapted to detect the acceleration of change of orientation of the crossing gate arm.

* * * * *

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Carlson et al.

(54) **COLLISION AVOIDANCE SYSTEM FOR RAIL LINE VEHICLES**

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(21) Appl. No.: **13/474,428**

(22) Filed: **May 17, 2012**

Related U.S. Application Data

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Publication Classification

(51) **Int. Cl.**

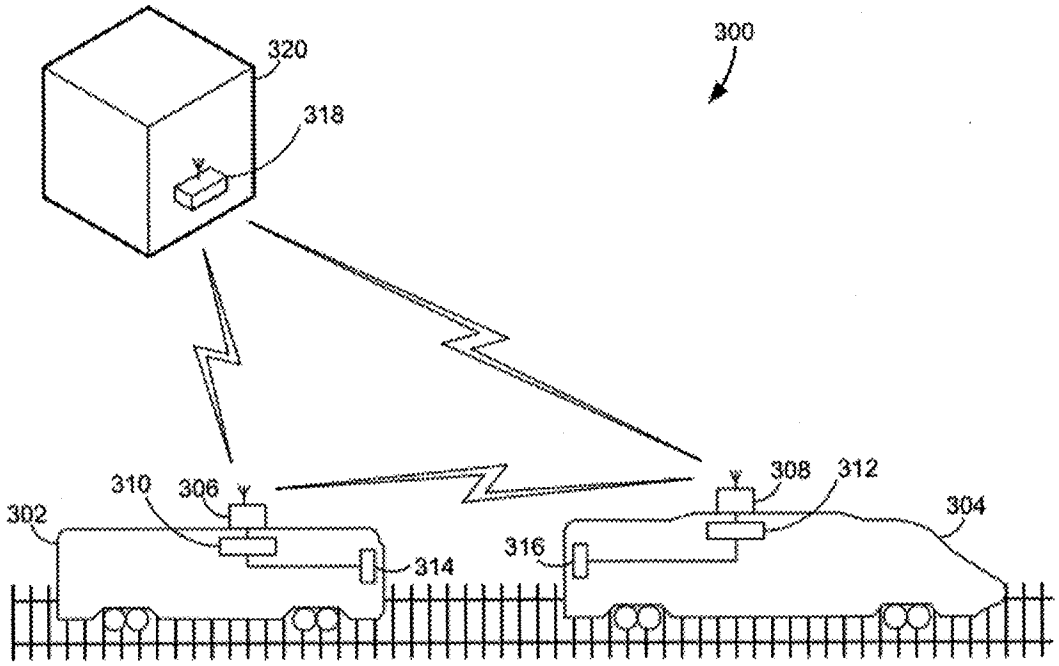
G08G 1/16 (2006.01)

B61L 25/02 (2006.01)

(52) **U.S. Cl.** **701/301**

(57) **ABSTRACT**

A collision avoidance system (CAS) is described that includes one or more sensor technologies, including, for example, an Ultra Wideband (UWB) sensing technology. The collision avoidance system is designed to reliably track the location and speed of vehicles and the distance between vehicles over a wide variety of track and terrain. The collision avoidance system may utilize information from a variety of sensor technologies to determine whether one or more vehicles violate speed and/or separation criteria, and may generate a warning.



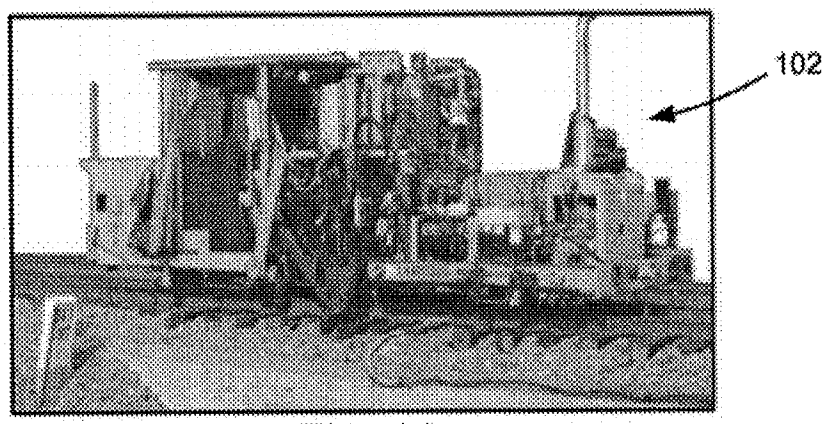


Fig. 1A

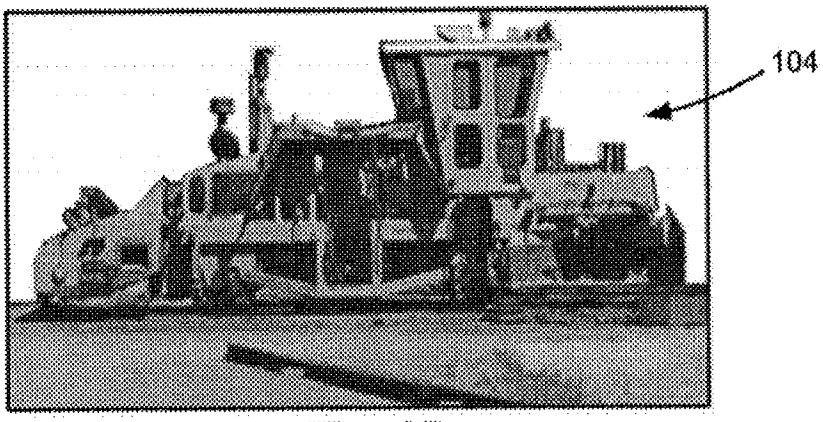


Fig. 1B

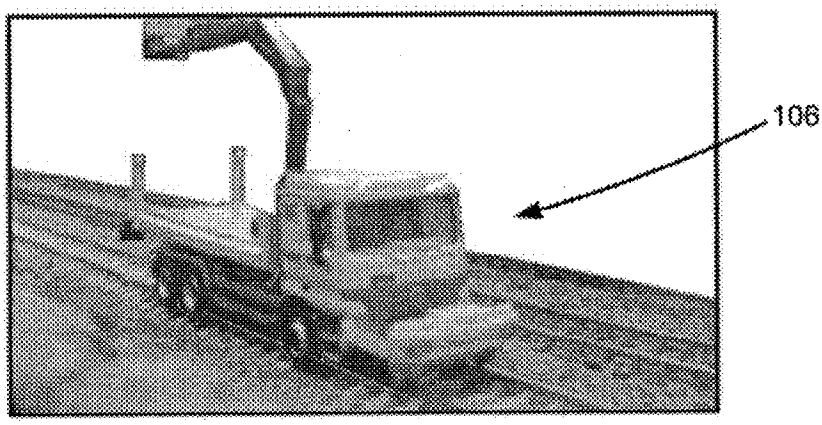
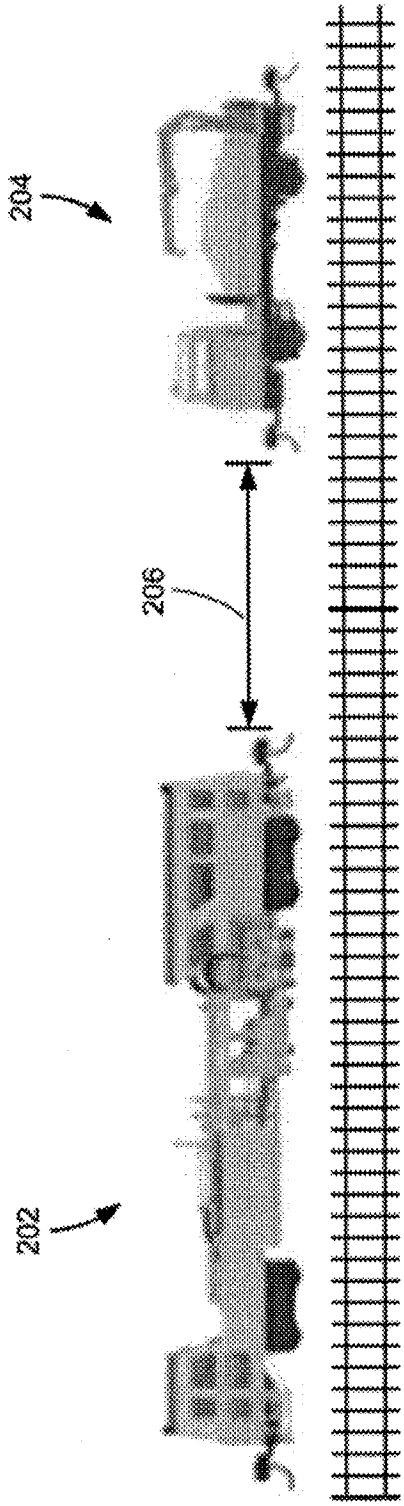


Fig. 1C

Fig. 2



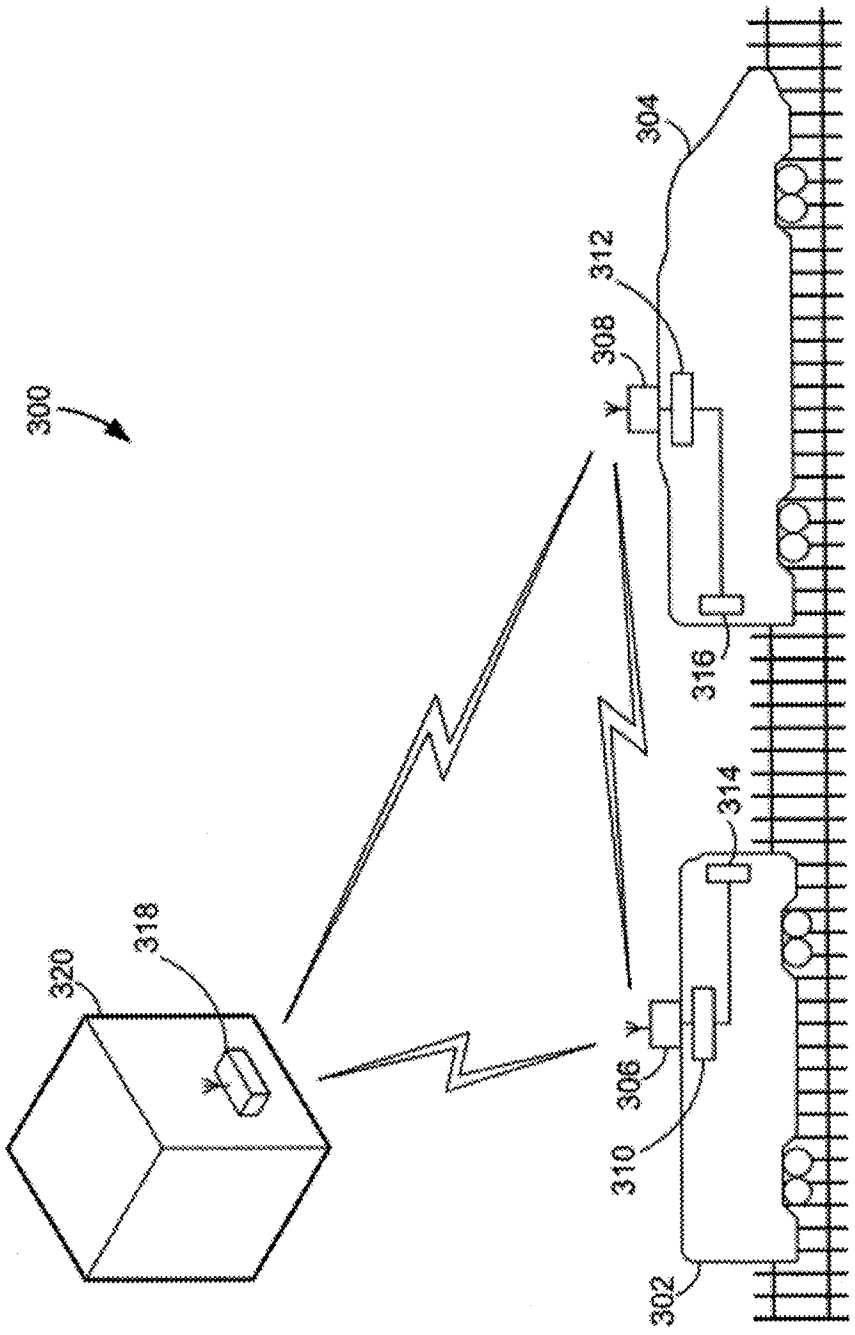


Fig. 3

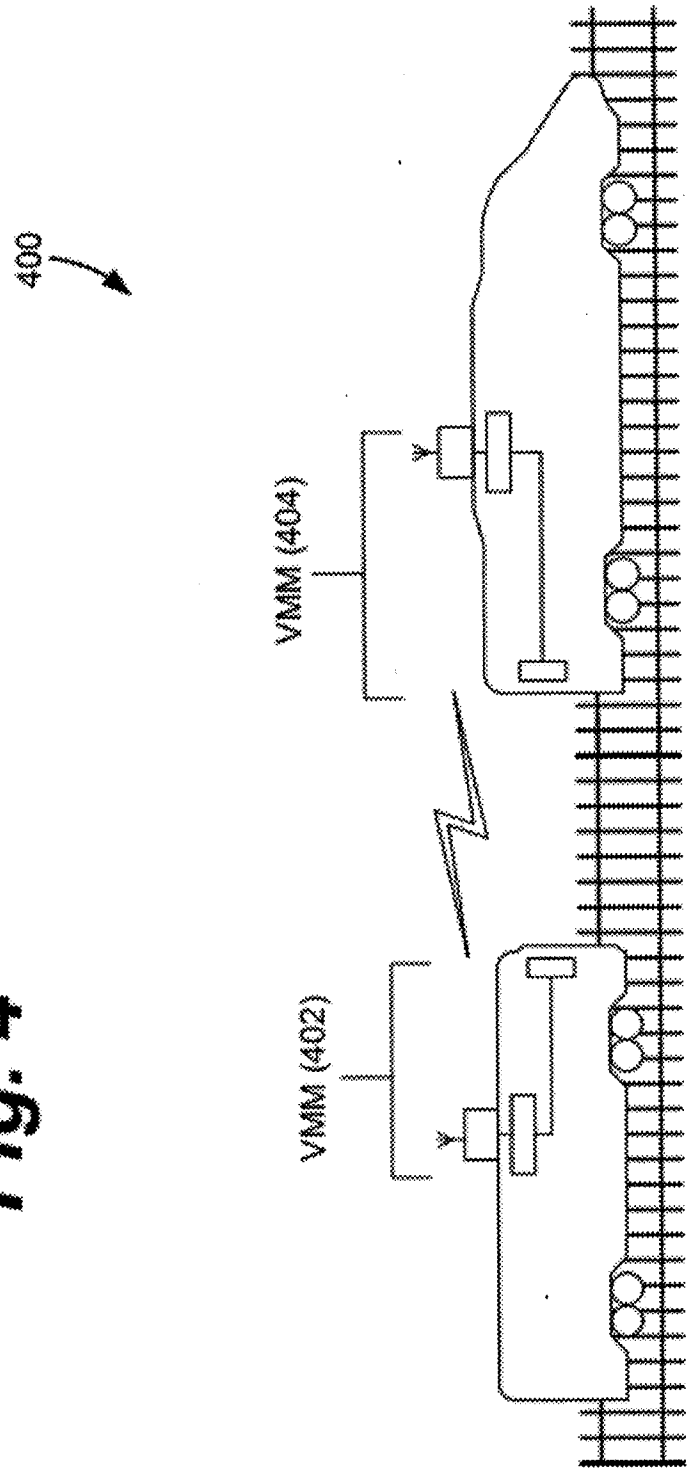
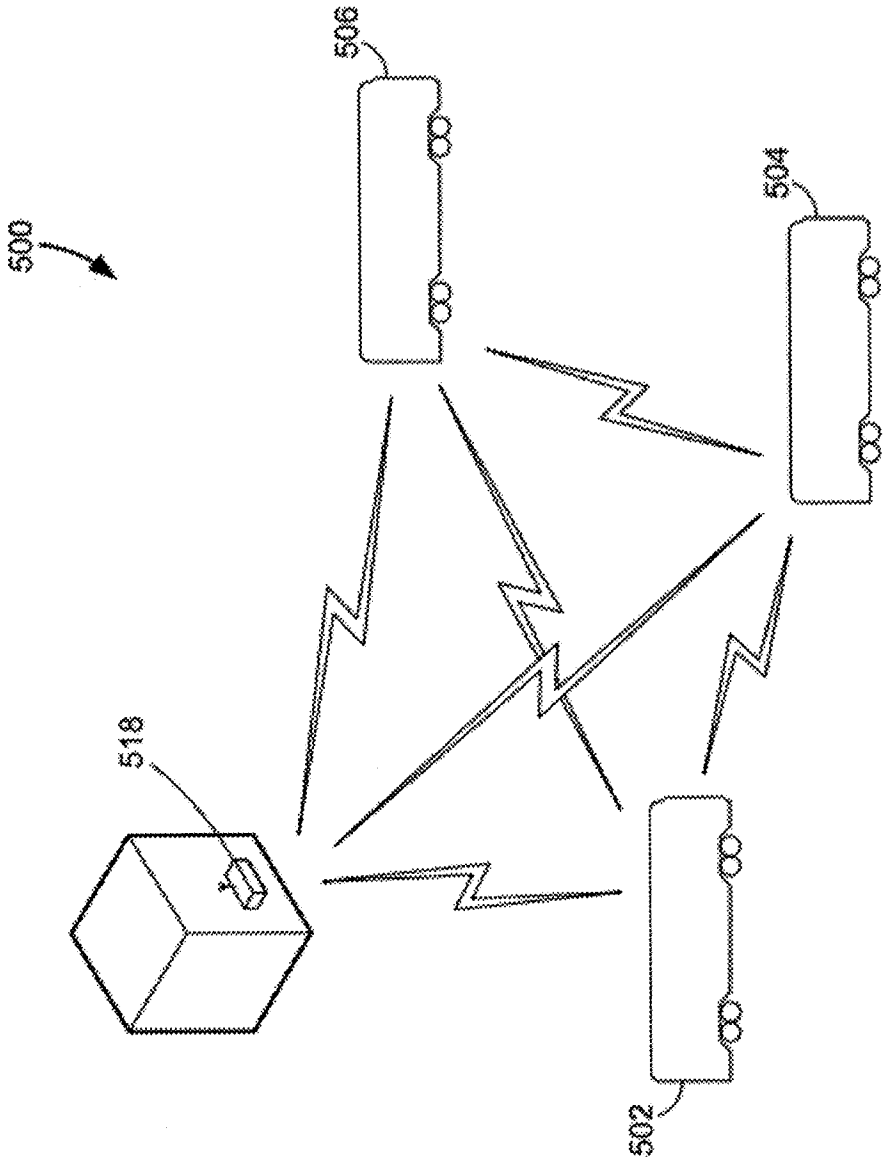


Fig. 4

Fig. 5



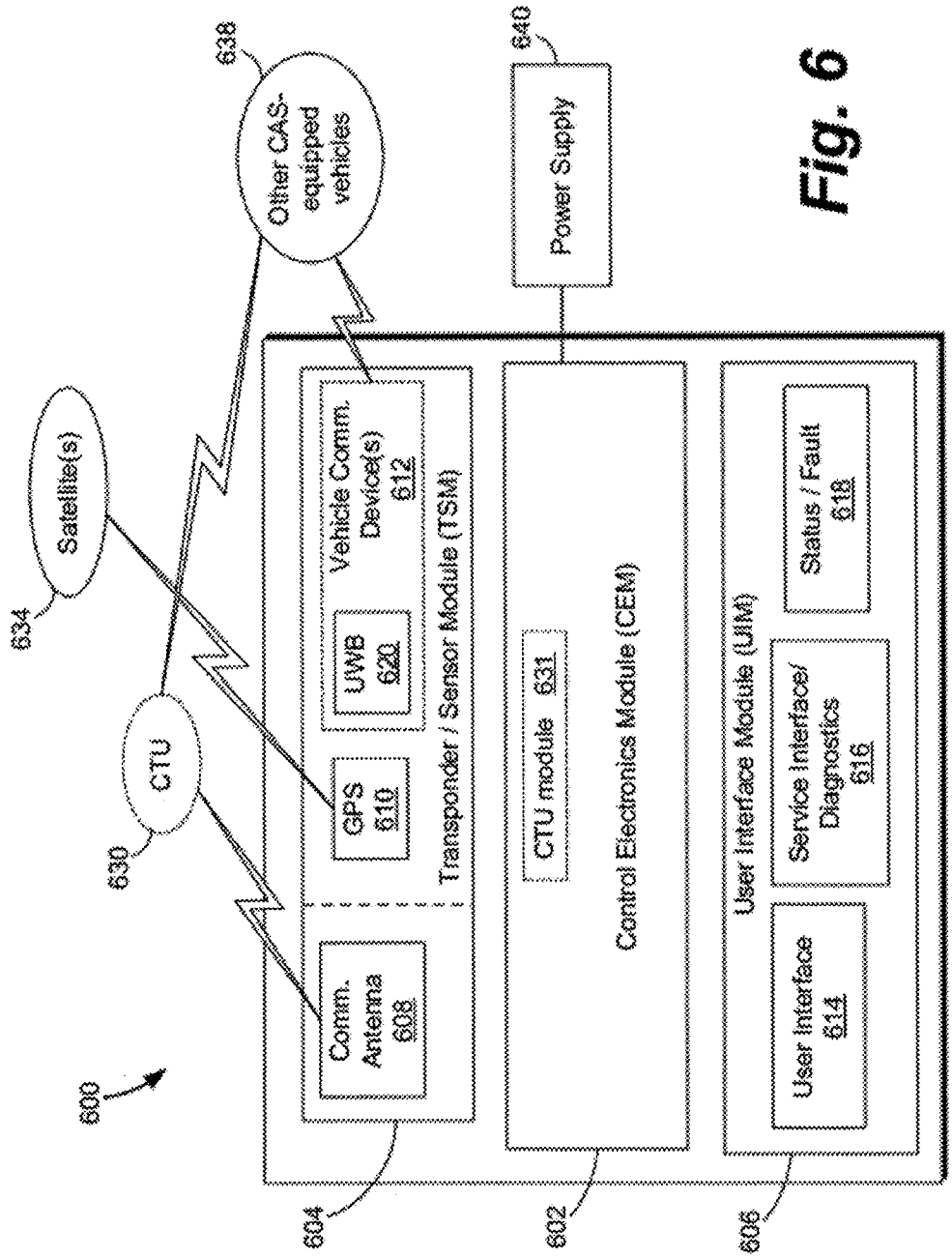

600
634
Satellite(s)
630
CTU
638
Other CAS-equipped vehicles
640
Power Supply
Comm. Antenna 608
GPS 610
UWB 620
Vehicle Comm. Device(s) 612
Transponder / Sensor Module (TSM)
604
CTU module 631
Control Electronics Module (CEM)
602
User Interface 614
Service Interface/ Diagnostics 616
Status / Fault 618
User Interface Module (UIM)
606

Fig. 6

Fig. 7

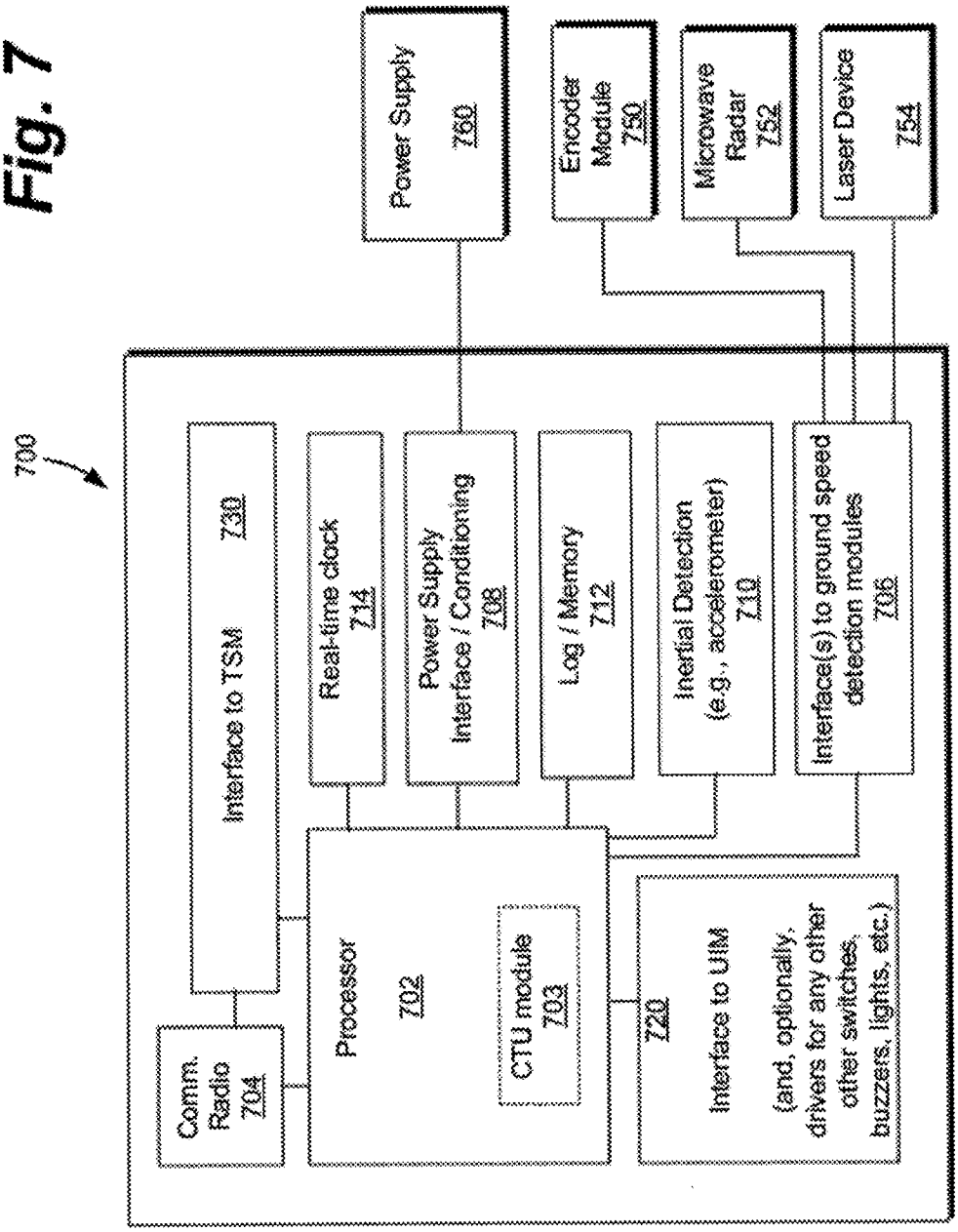

700
Power Supply
760
Encoder
Module
750
Microwave
Radar
752
Laser Device
754
Interface to TSM
730
Real-time clock
714
Power Supply
Interface / Conditioning
708
Log / Memory
712
Inertial Detection
(e.g., accelerometer)
710
Interface(s) to ground speed
detection modules
706
Comm.
Radio
704
Processor
702
CTU module
703
720
Interface to UIM
(and, optionally,
drivers for any other
other switches,
buzzers, lights, etc.)

Fig. 8

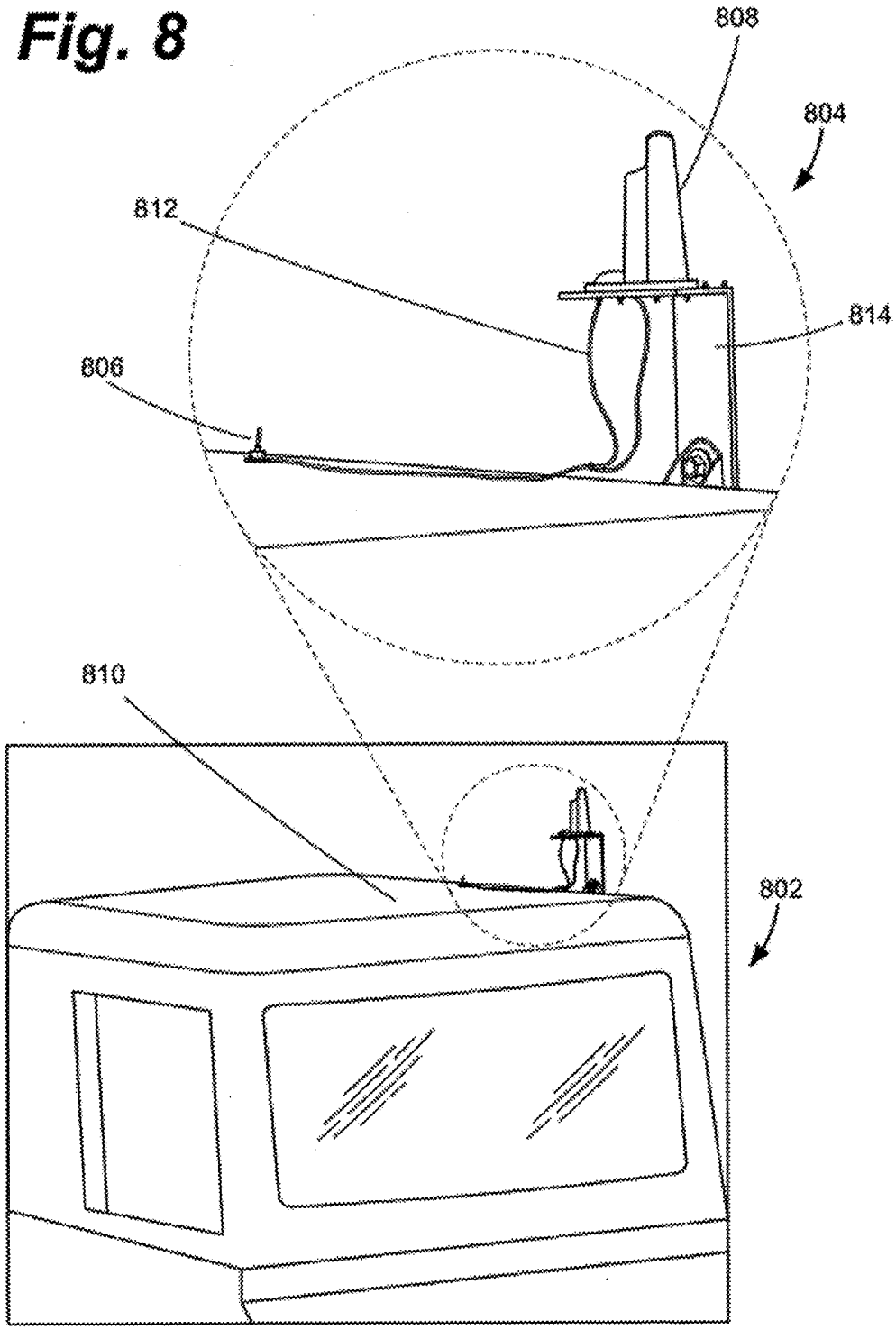
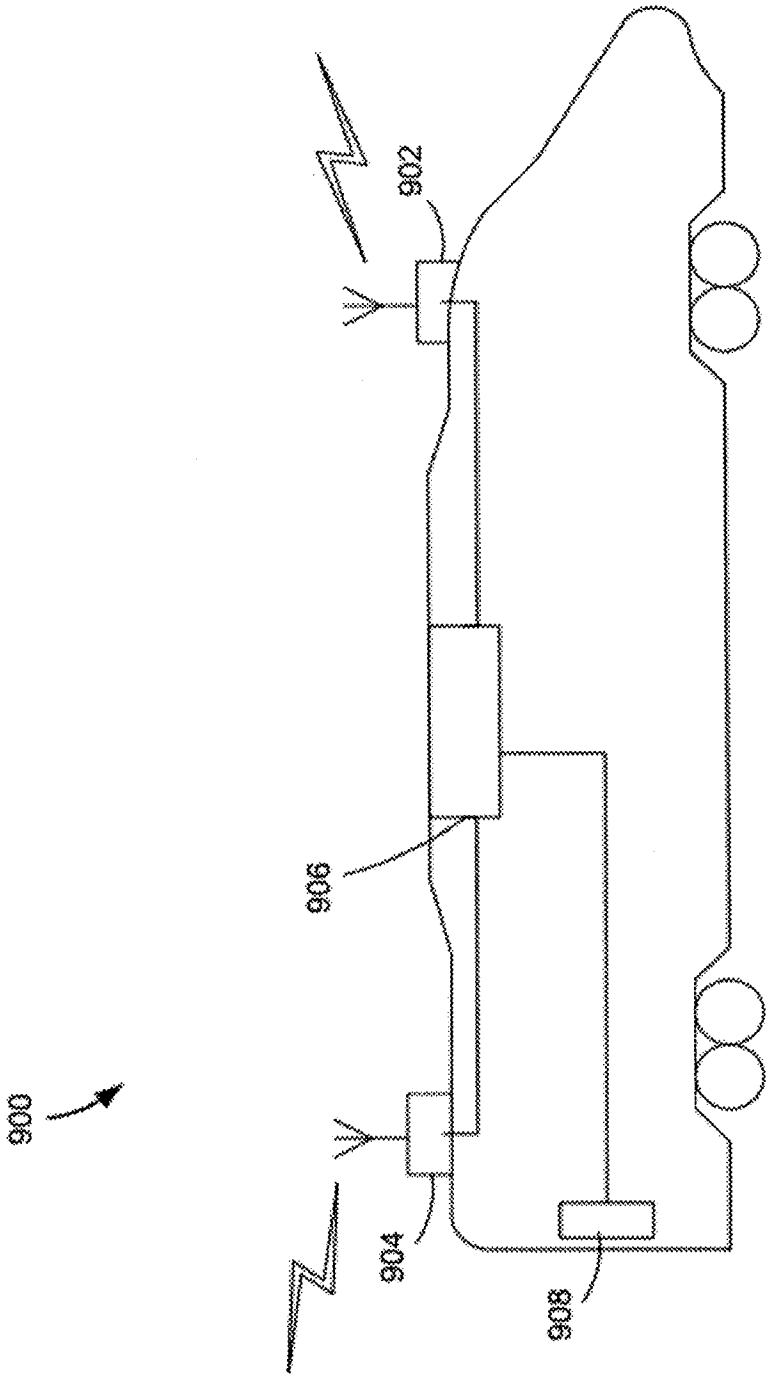


Fig. 9



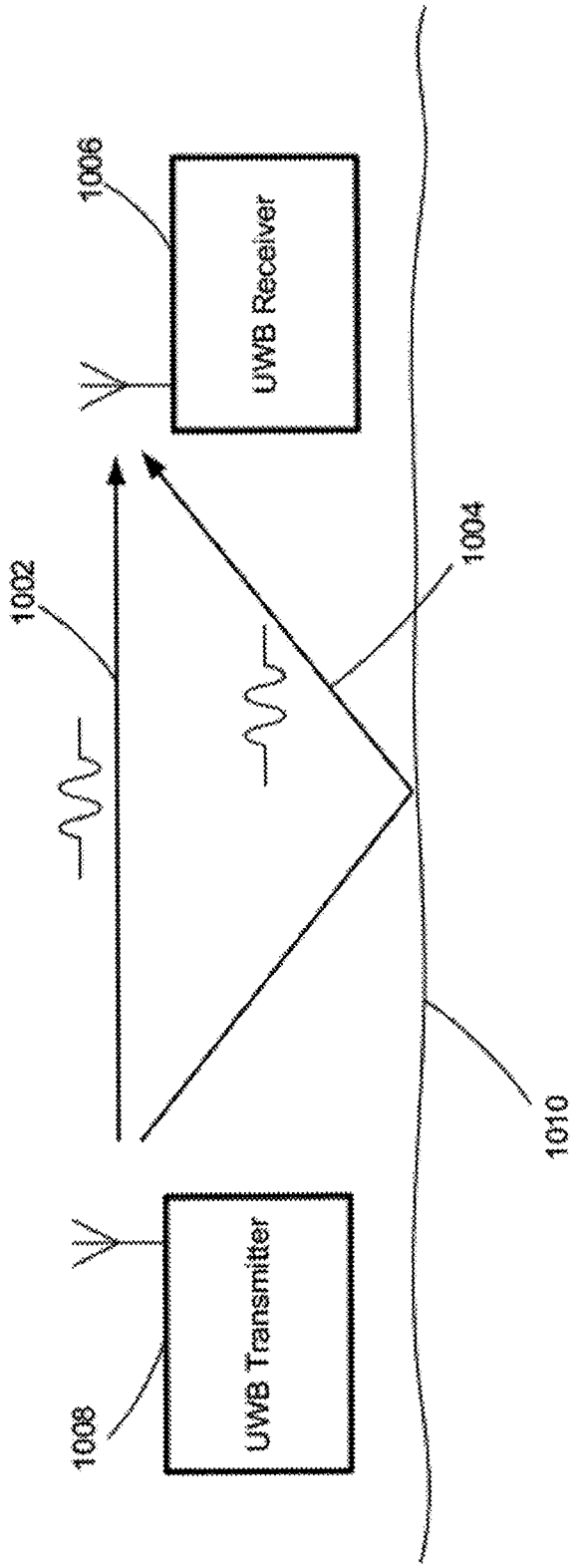


Fig. 10

Fig. 11

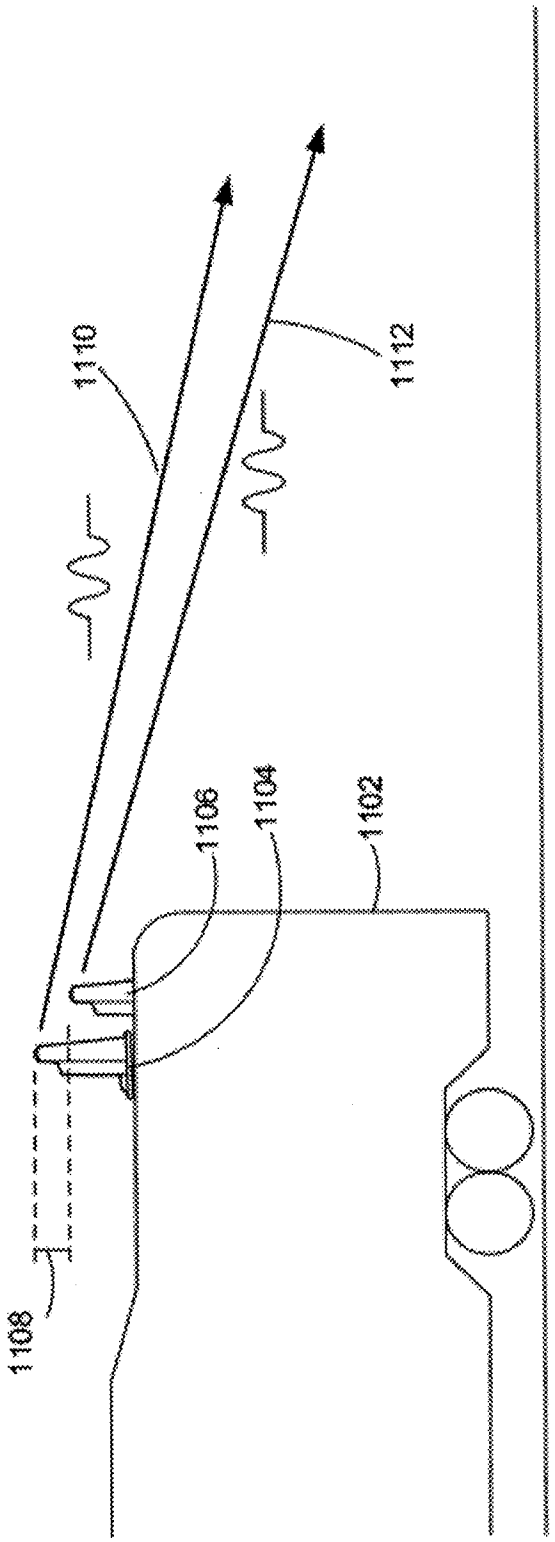


Fig. 12B

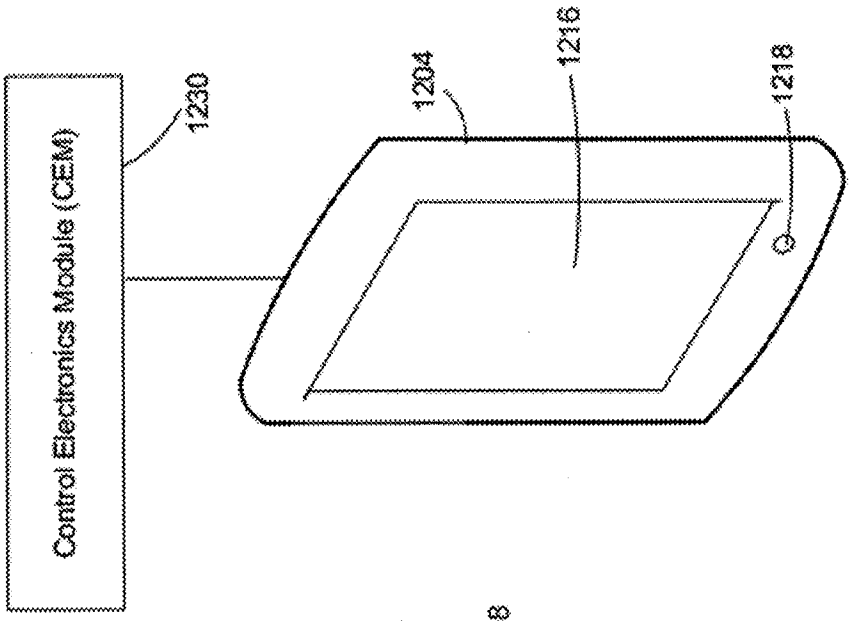
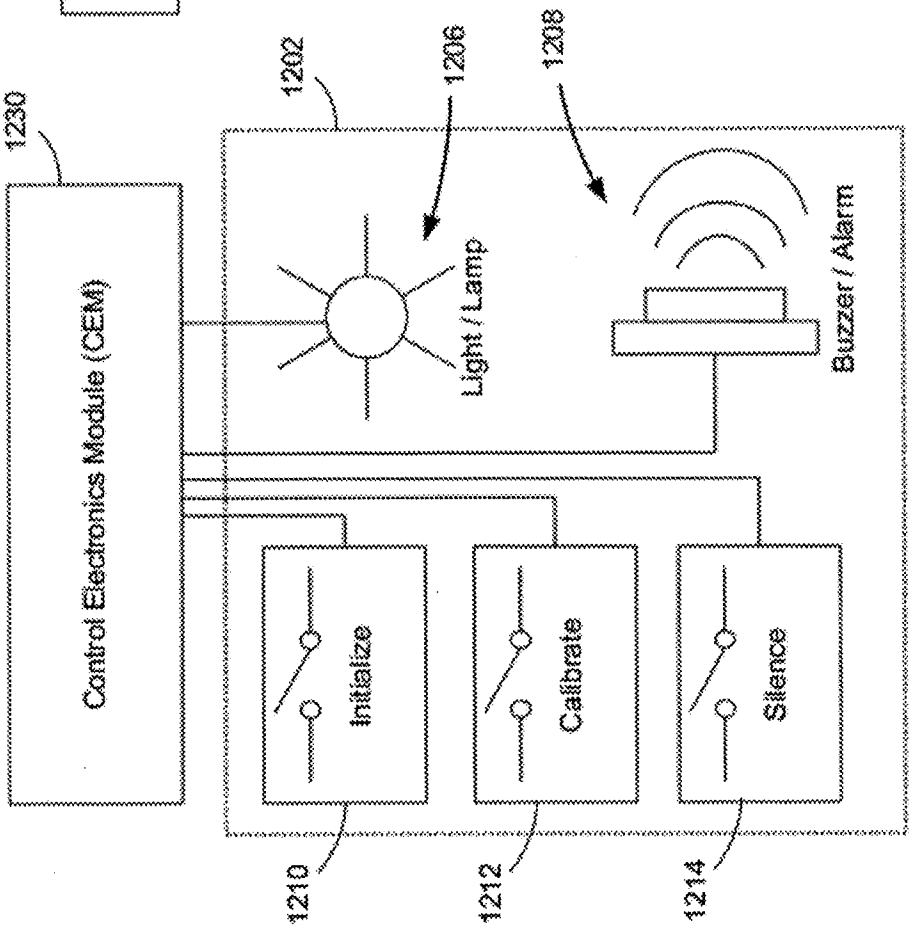
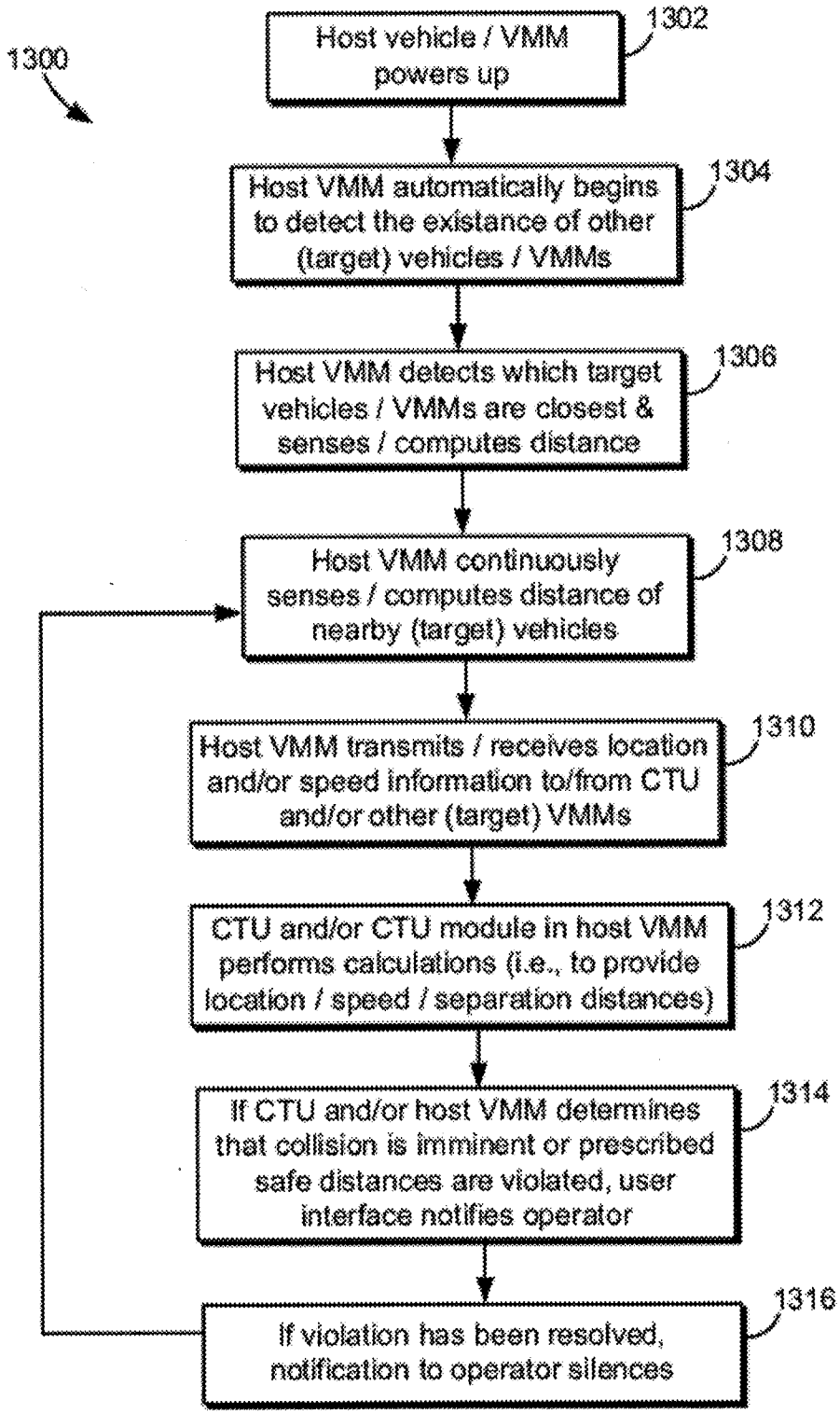
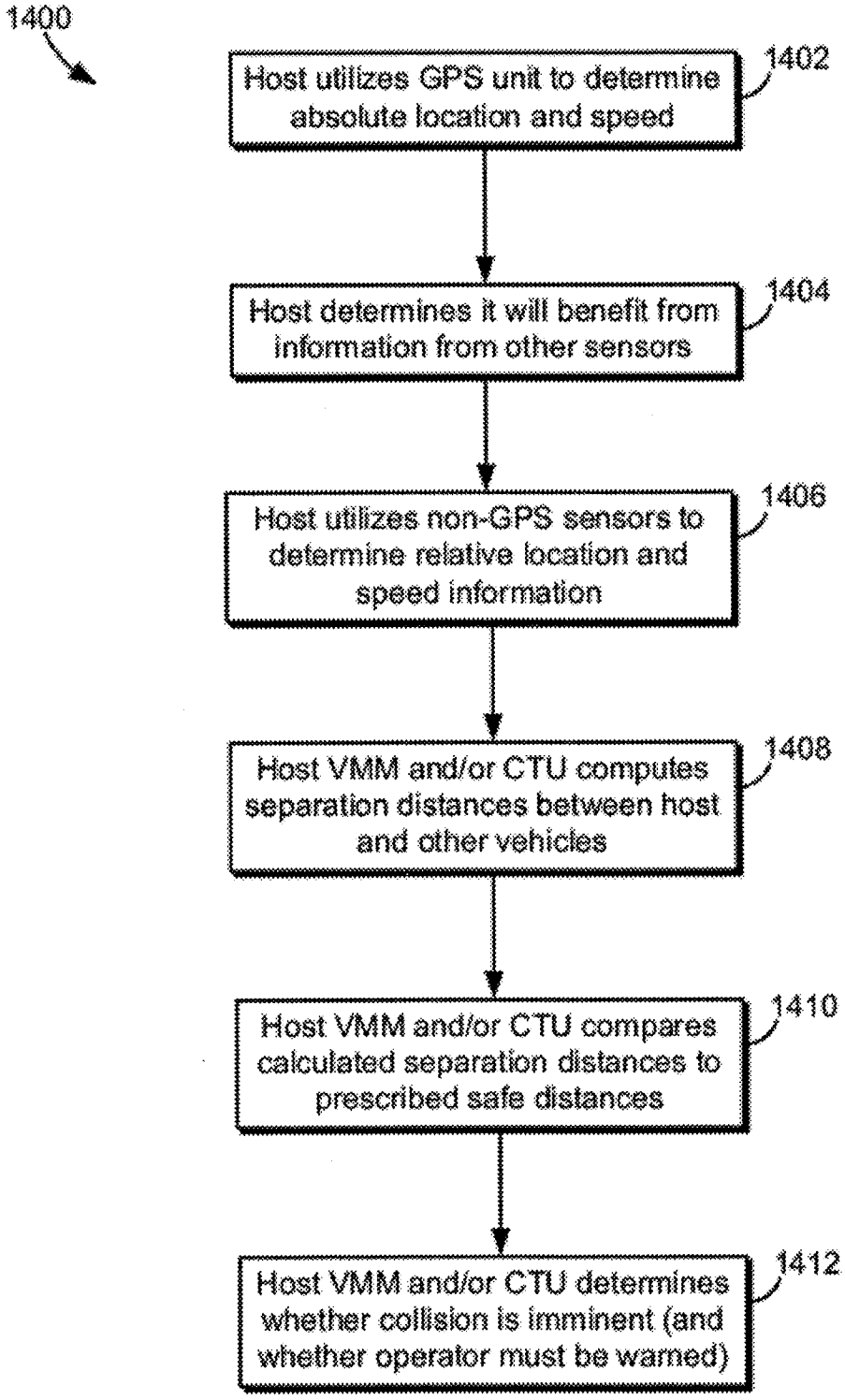
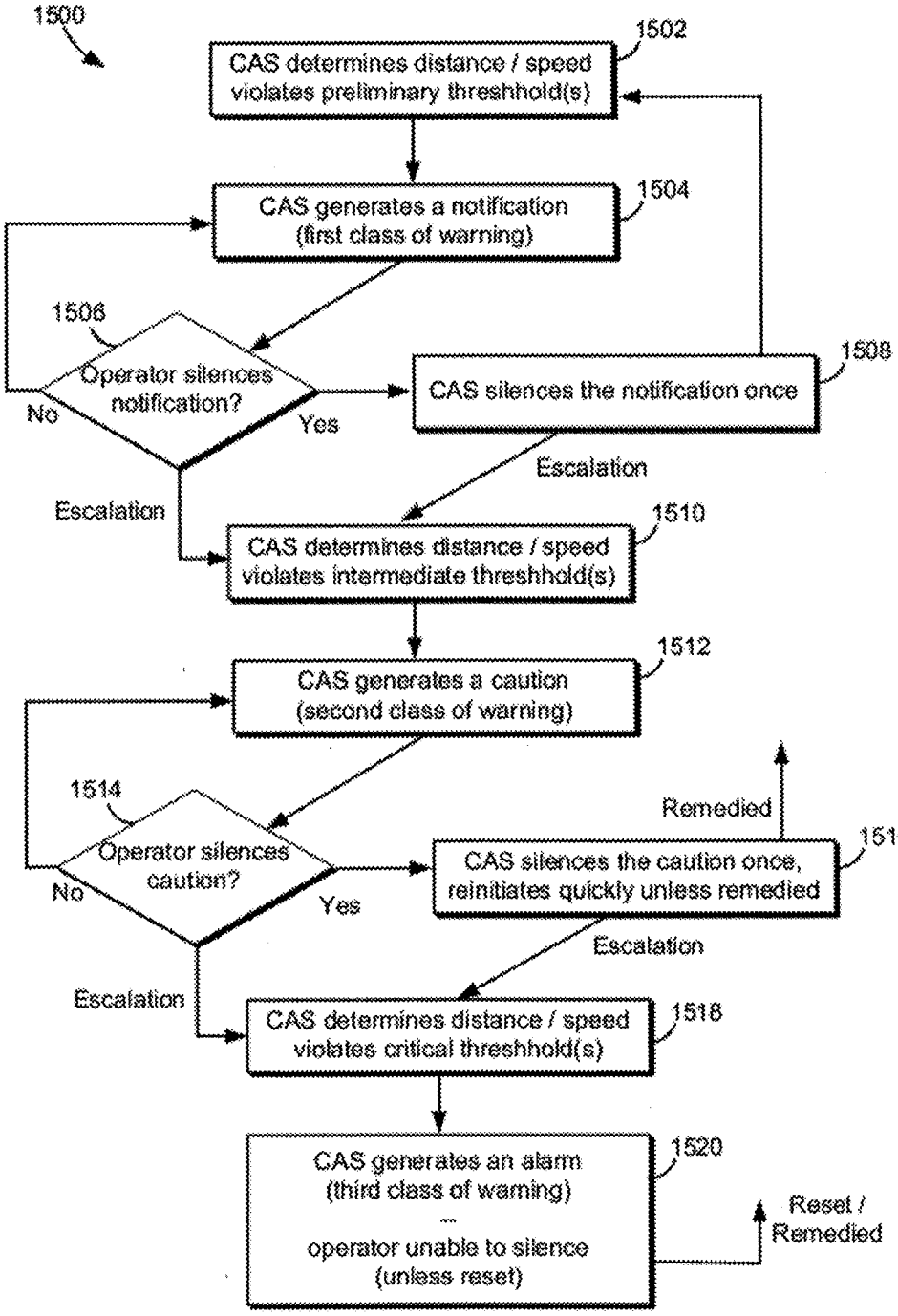


Fig. 12A




1300
Host vehicle / VMM powers up
1302
Host VMM automatically begins to detect the existance of other (target) vehicles / VMMs
1304
Host VMM detects which target vehicles / VMMs are closest & senses / computes distance
1306
Host VMM continuously senses / computes distance of nearby (target) vehicles
1308
Host VMM transmits / receives location and/or speed information to/from CTU and/or other (target) VMMs
1310
CTU and/or CTU module in host VMM performs calculations (i.e., to provide location / speed / separation distances)
1312
If CTU and/or host VMM determines that collision is imminent or prescribed safe distances are violated, user interface notifies operator
1314
If violation has been resolved, notification to operator silences
1316


1400
Host utilizes GPS unit to determine absolute location and speed
1402
Host determines it will benefit from information from other sensors
1404
Host utilizes non-GPS sensors to determine relative location and speed information
1406
Host VMM and/or CTU computes separation distances between host and other vehicles
1408
Host VMM and/or CTU compares calculated separation distances to prescribed safe distances
1410
Host VMM and/or CTU determines whether collision is imminent (and whether operator must be warned)
1412


1500
1502
CAS determines distance / speed violates preliminary threshhold(s)
1504
CAS generates a notification (first class of warning)
1506
Operator silences notification?
No
Yes
1508
CAS silences the notification once
Escalation
Escalation
1510
CAS determines distance / speed violates intermediate threshhold(s)
1512
CAS generates a caution (second class of warning)
1514
Operator silences caution?
No
Yes
Remedied
1516
CAS silences the caution once, reinitiates quickly unless remedied
Escalation
Escalation
1518
CAS determines distance / speed violates critical threshhold(s)
1520
CAS generates an alarm (third class of warning)
operator unable to silence (unless reset)
Reset / Remedied

COLLISION AVOIDANCE SYSTEM FOR RAIL LINE VEHICLES

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority from the following three U.S. Provisional Patent Applications: (1) No. 61/519,201 filed on May 19, 2011, (2) No. 61/627,697 filed on Oct. 17 2011, and (3) No. 61/598,750 filed on Feb. 14, 2012. The disclosures of these three applications are incorporated by reference herein in their entireties.

FIELD

[0002] Certain embodiments of the present disclosure relate to a collision avoidance system for use in the railroad industry. More particularly, certain embodiments of the present disclosure relate to one or more systems, methods, techniques and/or solutions that monitor the location of and separation distance between rail line vehicles, for example, railroad maintenance vehicles.

BACKGROUND

[0003] Railroad companies must perform maintenance on their tracks and other infrastructure associated with their rail lines. The railroad companies employ many different types of rail mounted vehicles to accomplish such maintenance, and these vehicles can range widely in their size, weight and shape because the vehicles perform a variety of tasks. These vehicles may be employed in one or more work gangs, each work gang including anywhere from four to forty vehicles. As such, many vehicles may be working in close proximity on a single track.

[0004] The speed at which the work gang is traveling, and each vehicle within the gang, can vary widely at any given time. For example, the work gang may be traveling to a work site, in which case the work gang, and each vehicle, is traveling at a higher rate of speed than when the vehicles are working at a worksite. When the vehicles are working at a work site, each vehicle is generally traveling at a lower rate of speed or not at all. Within a work gang, the speeds of the vehicles may vary depending on the task that each vehicle is performing.

[0005] Railroads have had several severe collisions and other accidents, some resulting in fatalities, when adequate spacing has not been maintained between rail mounted vehicles. Railroad companies now require that a specific spacing be maintained between vehicles when traveling to/from work sites and when working at a work site.

BRIEF SUMMARY

[0006] One or more systems, methods, techniques and/or solutions are provided for a collision avoidance system for use in the railroad industry that may monitor the location of and separation distance(s) between rail line vehicles, for example railroad maintenance vehicles, substantially as shown in and/or described in connection with at least one of the figures, as set forth more completely in the claims.

[0007] These and other advantages, aspects and novel features of the present invention, as well as details of an illustrated embodiment thereof, will be more fully understood from the following description and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIGS. **1**A-1C depict illustrations of example rail line vehicles that may utilize a collision avoidance system, in accordance with one or more embodiments of the present disclosure.

[0009] FIG. **2** depicts illustrations of example rail line vehicles that may utilize a collision avoidance system, in accordance with one or more embodiments of the present disclosure.

[0010] FIG. **3** depicts an illustration of an example collision avoidance system, in accordance with one or more embodiments of the present disclosure.

[0011] FIG. **4** depicts an illustration of an example collision avoidance system, in accordance with one or more embodiments of the present disclosure.

[0012] FIG. **5** depicts an illustration of an example collision avoidance system, in accordance with one or more embodiments of the present disclosure.

[0013] FIG. **6** depicts a block diagram of an example vehicle mounted module, in accordance with one or more embodiments of the present disclosure.

[0014] FIG. **7** depicts a block diagram of an example control electronics module, in accordance with one or more embodiments of the present disclosure.

[0015] FIG. **8** depicts an illustration of side angled view of the upper portion of an example rail line vehicle and an example component mounting configuration, in accordance with one or more embodiments of the present disclosure.

[0016] FIG. **9** depicts an illustration of an example rail line vehicle, including a vehicle mounted module, in accordance with one or more embodiments of the present disclosure.

[0017] FIG. **10** depicts a block diagram illustrating example Ultra Wideband units, in accordance with one or more embodiments of the present disclosure.

[0018] FIG. **11** depicts an illustration of a side view of an example rail line vehicle including multiple Ultra Wideband units, in accordance with one or more embodiments of the present disclosure.

[0019] FIGS. **12**A and **12**B depict illustrations of example user interfaces, in accordance with one or more embodiments of the present disclosure.

[0020] FIG. **13** depicts a flow diagram that shows exemplary steps in the operation of a collision avoidance system, in accordance with one or more embodiments of the present disclosure.

[0021] FIG. **14** depicts a flow diagram that shows exemplary steps in the operation of a collision avoidance system, in accordance with one or more embodiments of the present disclosure.

[0022] FIG. **15** depicts a flow diagram that shows exemplary steps in the operation of a collision avoidance system, in accordance with one or more embodiments of the present disclosure.

DETAILED DESCRIPTION

[0023] Previous systems for preventing collisions of rail line vehicles have typically utilized a single sensor, for example a GPS or radar-based sensor, to monitor the approximate location of rail mounted vehicles. A shortcoming of single sensor systems, such as ones that depend on GPS

sensors, is that the rail vehicles being monitored often enter into "blackout" areas (for example, around buildings, in the mountains, canyons, around sharp curves or in tunnels) where the single sensor may be unable to accurately determine the vehicle's location. For example, a GPS sensor may be unable to communicate with satellites when the vehicle is in a tunnel. Some previous systems attempted to solve this problem by performing a simple "dead reckoning" calculation, where the last known speed and direction of the vehicle are used to estimate the current position of the vehicle until the sensor signal is reestablished. This estimation calculation may not be precise enough to prevent collisions in work gangs because of the speed variation between vehicles. When the vehicles are traveling to a work site, the higher speeds introduce the risk of collision, and when the vehicles are working at a work site, the vehicle are frequently stopping and starting, and this variation in speed between vehicles renders the dead reckoning approach an unsuitable approximation.

[0024] A limitation of radar-based sensors in particular is that they may initiate numerous false positives (warning alarms that are not warranted). With the normal clutter of maintenance operations (people, equipment, trains on adjacent tracks, trackside structures, trestle sides, tunnel walls), radar-based sensors can become confused as to when vehicles are actually in danger of colliding. More specifically, radar-based sensors must deal with the following dilemma: the sensor must scan a wide enough field so that it can detect collision risks when vehicles are traveling on curves at higher speeds, yet as radar-based sensors scan wider fields, they become more susceptible to false detections, for example because the sensor also senses clutter. False detections can result in a dangerous work environment, especially if operators become immune to warnings.

[0025] The present disclosure describes a collision avoidance system (CAS) for rail line vehicles that may utilize a combination of sensor technologies, including an Ultra Wideband (UWB) sensing technology, to counter the limitations of previous systems, and to significantly reduce the potential for vehicle collisions and to enhance the safe operation of a variety of railway vehicles. The present technology is designed to reliably track the location and speed of railway vehicles, as well as the distance between vehicles over a wide variety of track and terrain conditions. The present technology may monitor the separation distance between rail line vehicles by utilizing sensors that are mounted on each vehicle in a group or work gang, where a work gang may comprising a plurality of railway vehicles, including railway maintenance equipment.

[0026] The CAS may perform the techniques and/or solutions described herein for a wide variety of railway vehicles, for example, railway maintenance equipment/vehicles, railcars, hyrail vehicles, train cars, train engines and other rail line vehicles. FIGS. **1A-1C** depict illustrations of types of example rail line vehicles (vehicles **102, 104, 106**) that may utilize a CAS or that a CAS as described herein may track. FIGS. **1A** and **1B** may depict example rail line maintenance vehicles and FIG. **1C** may depict an example hyrail vehicle. FIG. **2** depicts illustrations of more example rail line vehicles (vehicles **202, 204**) that may utilize a CAS or that a CAS system may track, and also shows an exemplary safe distance **206** between the two vehicles **202, 204**. The CAS may track vehicles such as the ones depicted in FIGS. **1** and **2** (and others) over a wide range of terrain (e.g., mountains, canyons, hills, trees, tunnels, curves and trestles) and during a variety of weather conditions (e.g., rain, fog, snow, ice, bright sunlight).

[0027] The CAS may be designed to introduce redundancy into the system, for example in the form of multiple types of sensor technologies and/or multiple sensors of a particular type of technology. One benefit of utilizing redundant sensors may be that some sensors may function properly when other sensors are not functioning optimally or at all. Another benefit of utilizing redundant sensors is that different sensors may be adapted to sense objects and different distances and to different levels of accuracy. In some embodiments, a CAS may utilize a combination of distance sensors so that the CAS is adapted to detect vehicles that are either close or far away, and so that the CAS may detect vehicle separation to within a few inches if the vehicles are close.

[0028] Various embodiments of the present disclosure enable a rail line vehicle having a vehicle mounted module. The vehicle mounted module may comprise a transponder sensor module that includes an ultra wideband unit and a wireless communications antenna. The ultra wideband unit may be operable to detect a distance between the rail line vehicle and at least one other vehicle. The wireless communications antenna may be operable to send and receive data over the air. The vehicle mounted module may further comprise a control electronics module that includes a processor that is in communication with at least the ultra wideband unit. The vehicle mounted module may further comprise a user interface module including a user interface. The user interface may be operable to provide a vehicle operator with information and may be operable to accept input from the vehicle operator. The vehicle mounted module may be in communication with one or more central tracking units by way of the wireless communications antenna. The one or more central tracking units may be operable to track the location of the rail line vehicle and at least one other vehicle.

[0029] In some embodiments, the vehicle mounted module further comprises a central tracking unit module that is operable to track the location of at least one other vehicle. In some embodiments, the vehicle mounted module may be operable to utilize information generated by the global positioning system and the ultra wideband unit to determine whether one or more vehicle separation criteria are violated, and generate a warning if one or more vehicle separation criteria are violated. In some embodiments, the vehicle mounted modules comprises one or more additional transponder sensor modules. The vehicle mounted module may be operable to accept calibration information regarding the length of the rail line vehicle and the mounting locations of the transponder sensor module and the one or more additional transponder sensor modules.

[0030] In some embodiments, the transponder sensor module further includes a global positioning system. The global positioning system may be operable to receive information from one or more satellites and may be operable to determine the absolute position of the rail line vehicle. In some embodiments, the transponder sensor module further includes one or more of a laser device, a radar sensor and an infrared sensor. In some embodiments, the vehicle mounted modules may comprise an additional ultra wideband unit, wherein an offset exists between the ultra wideband unit and the additional ultra wideband unit once the two units are mounted on the rail line

vehicle. In some embodiments, the ultra wideband unit is adapted to transmit and receive signals with varying center frequencies.

[0031] In some embodiments, the user interface module further includes a service interface that may be operable to allow the vehicle operator to configure, calibrate, service, maintain, diagnose, update and/or install information on vehicle mounted module. In some embodiments, the user interface is a touchscreen including a screen. The touchscreen may be operable to display one or more screens, menus, options and/or functions, and accept user input from the vehicle operator by allowing the vehicle operator to touch the screen of the touchscreen.

[0032] In some embodiments, the control electronics module further includes one or more interfaces that may be operable to communicate with ground speed detection modules. The ground speed detection modules may include one or more of a microwave radar, a laser device, an infrared sensor and an ultra wideband sensor. In some embodiments, the control electronics module further includes one or more inertial measurement units. In some embodiments, the control electronics module further includes an inertial measurement unit.

[0033] In some embodiments, the vehicle mounted module may be operable to utilize a progressive warning feature that generates a warning if one or more vehicle separation thresholds are violated. The rate, frequency, prominence and/or severity of the warning may increase as the violation of the vehicle separation threshold becomes more critical. The progressive warning feature may utilize an adaptive threshold feature that modifies the one or more vehicle separation thresholds based on the speed of the rail line vehicle and the speed of one or more nearby vehicles. In some embodiments, the vehicle mounted module may be operable to utilize a stopping distance calibration feature that measures a stopping distance. The stopping distance may indicate how quickly the rail line vehicle can stop under current conditions. The measured stopping distance may be used to modify one or more safe separation distance thresholds.

[0034] Various embodiments of the present disclosure enable a collision avoidance system for rail line vehicles that may comprise one or more vehicle mounted modules, each mounted on a vehicle. Each vehicle mounted module may comprise a transponder sensor module including an ultra wideband unit and a wireless communications antenna. The ultra wideband unit may be operable to detect a distance between the vehicle on which the vehicle mounted module is mounted and at least one other vehicle. The wireless communications antenna may be operable to send and receive data over the air. Each vehicle mounted module may comprise a control electronics module including a processor that is in communication with at least the ultra wideband unit. Each vehicle mounted module may comprise a user interface module including a user interface. The user interface may be operable to provide a vehicle operator with information and may be operable to accept input from the vehicle operator.

[0035] The collision avoidance system that may comprise a central tracking unit that is in communication with the one or more vehicle mounted modules. The central tracking unit may be operable to track the location of the one or more vehicle mounted modules. In some embodiments, the central tracking unit may be distributed among the one or more vehicle mounted modules, wherein each of the one or more vehicle mounted modules includes a central tracking unit component. Each central tracking unit component may be in communication with the vehicle's control electronics module. In some embodiments, the central tracking unit may be disposed in a discrete housing.

[0036] In some embodiments, the transponder sensor module further includes a global positioning system. The global positioning system may be operable to receive information from one or more satellites and may be operable to determine the absolute position of the vehicle mounted module. Each vehicle mounted module may be operable to utilize information generated by the global positioning system, the ultra wideband unit and the central tracking unit to determine whether one or more vehicle separation criteria are violated, and generate a warning if one or more vehicle separation criteria are violated.

[0037] FIG. **3** depicts an illustration of an example collision avoidance system (CAS) **300** for rail line vehicles according to one or more embodiments of the present disclosure. For example purposes only, FIG. **3** depicts a work gang including only two vehicles **302**, **304**. In this embodiment, the CAS **300** includes four main types of components—transponder sensor modules (TSMs) (for example, TSMs **306**, **308**), control electronics modules (CEMs) (for example, CEMs **310**, **312**), user interface modules (UIMs) (for example, UIMs **314**, **316**) and a central tracking unit (CTU) (for example, CTU **318**). Referring to a single vehicle (vehicle **302** for example), modules that are located in or on the vehicle (for example, TSM **306**, CEM **310** and UIM **314**) may collectively be referred to as the vehicle mounted module (VMM), even though the individual modules and related components may or may not be housed within a unitary package/enclosure.

[0038] In some embodiments, the VMM components may not be installed on vehicles at production. In these examples, the VMM components may be designed to allow retrofitting into existing railway vehicles without requiring heavily intrusive installation.

[0039] The CAS may include a central tracking unit (CTU), for example the CTU **318** of FIG. **3**. The CTU may operate to centrally track all the vehicles in one or more work gangs. The CTU may adapt a tracking software and/or system to monitor individual vehicles. The CTU may include technology adapted to dynamically define which vehicles are in a work gang, and/or which vehicles the CTU should keep track of. The CTU may accept information from VMMs mounted inside vehicles in the work gang, information such as location, speed, separation distance and the like. The CTU may have the ability to analyze and/or store various types of data about vehicles in one or more work gangs. For example, the CTU may analyze absolute and relative positioning data and speed data from vehicles in the work gang. In some examples, the CTU may determine if a separation distance between two vehicles has been violated, indicating that an accident may be likely. Additionally, the CTU may track alarm status of the vehicles in a work gang so that the central tracking unit becomes aware when an accident may have occurred. In another example, the central tracking unit may track data regarding accidents.

[0040] In the embodiment depicted in FIG. **3**, the CTU **318** may be located in a discrete housing **320** (also referred to as a module, unit, bungalow or the like). It should be understood that the technology and features of the CTU need not reside in such a discrete housing **320** and may be distributed amongst the vehicles in the work gang, for example with a CTU module/component in each VMM. In embodiments where the

CTU is located in a housing **320** that is discrete from the vehicles, the VMM may include a TSM, CEM, and UIM. In embodiments where the CTU is distributed amongst the vehicles, the VMM may further include a CTU module/component.

[0041] FIG. **4** depicts an illustration of an example collision avoidance system (CAS) **400** according to one or more embodiments of the present disclosure. In this embodiment, the system **400** does not include a discrete housing for the CTU technology. This embodiment still utilizes technology, functionality and features similar to those employed in a system (such as the CAS **300** of FIG. **3**) with a CTU disposed in a discrete housing. In this embodiment, the functionality and intelligence of the CTU is dispersed and/or distributed among the VMMs (for example VMMs **402**, **404**) in the vehicles within a work gang. With this dispersed design (also referred to as "dispersed thinking"), each VMM includes its own CTU module/component that tracks the location of other vehicles in the work gang, like a CTU disposed in discrete housing would do. It should also be understood that although this embodiment describes a central tracking unit component, the central tracking unit circuitry and technology may be incorporated into other components/subcomponents of the VMM, such as the CEM.

[0042] For example purposes, FIGS. **3** and **4** each show a work gang including only two vehicles, but it should be understood that work gangs may include more than two vehicles. FIG. **5** depicts an illustration of an example collision avoidance system (CAS) **500** with a work gang that includes more than two vehicles, according to one or more embodiments of the present disclosure. In this embodiment, each vehicle (for example, vehicles **502**, **504**, **506**) in the work gang may be equipped with a VMM and each VMM may communicate with nearby VMMs (in nearby vehicles) as well as with a CTU **518** in a discrete housing, as can be seen in FIG. **5**. In other embodiments of the present disclosure, each vehicle in a work gang is equipped with a VMM and each VMM communicates with nearby VMMs (in nearby vehicles) including a CTU module/component within each VMM (not depicted in FIG. **5**). In these embodiments, there may be no CTU in a discrete housing such as the CTU **518** depicted in FIG. **5**. FIG. **5** depicts a work gang with three vehicles, but it should be understood that a work gang may include more than three vehicles. As the size of the work gang becomes larger, the VMM mounted on each vehicle may communicate with more VMMs (in nearby vehicles), as well as with the CTU in a discrete housing (or a CTU module/component within the VMMS in each vehicle).

[0043] FIG. **6** depicts a block diagram of an example vehicle mounted module (VMM) **600**, in accordance with one or more embodiments of the present disclosure. The VMM may include one or more control electronics modules (CEM) **602**, one or more transponder sensor modules (TSM) **604**, and one or more user interface modules (UIM) **606**. The TSM **604** may further include a wireless communications antenna **608** (for example an RF antenna such as a 2.4 GHz radio antenna) that is operable to send and receive data over the air, for example to/from remote systems. The TSM **604** may further include a GPS unit **610** one or more vehicle communication devices **612**. The UIM **606** may further include a user interface **614**, a service interface **616** (optionally including diagnostics components/interfaces) and status/fault indicators **618**. Additionally, the VMM **600** may receive power from a power supply **640** that may provide power to one or more vehicle mounted module components, for example components disposed within the CEM **602**.

[0044] Wireless communications antenna **608** may be, for example, an RF antenna such as a 2.4 GHz radio antenna. As depicted in FIG. **6**, a VMM **600** may communicate with a CTU **630** (for example a CTU located in a discrete housing or a number of CTU modules located in other VMMs) through a wireless communications antenna **608**. The wireless communications antenna **608** may be housed in the TSM, or it may be housed separately and perhaps connected to CEM **602** independently. The circuitry for the radio associated with the wireless communications antenna **608** may be disposed in the TSM **604**, or may be disposed in the CEM **602** and be connected to the wireless communications antenna **608** via a wired connection. The VMM **600** may transmit a variety of information to the CTU **630**, for example, absolute position data, relative position data and speed data of the vehicle. Such information may have been obtained by the VMM utilizing various components and/or sensors, for example, the GPS unit **610**, the UWB unit **620**, and/or other sensors. The VMM **600** may transmit other information to the CTU **630**, for example, status/fault and/or diagnostic information regarding the health of the VMM and its components. The VMM **600** may gather data from one or more satellites **634** utilizing a GPS unit **610**, for example to acquire absolute positioning information. The VMM **600** may communicate with other CAS/VMM-equipped vehicles through one or more vehicle communication devices **612** and/or through a wireless communications antenna **608**. In some embodiments, the vehicle communications devices **612** may include one or more separate wireless communications antennas (and perhaps associated radios) from antenna **608**.

[0045] Referring to FIG. **6**, in some embodiments, a CAS may not include a discrete CTU such as the one shown in FIG. **6** at CTU **630**. In these embodiments, the VMM may include a CTU module/component **631** that tracks the location of (and provides location information to) other vehicles in the work gang by communicating with other CAS/VMM-equipped vehicles directly. The CTU module/component **631** may operate like (and include similar technology to) a discrete CTU (such as CTU **630**) would operate in other embodiments. The CTU module/component may include technology adapted to dynamically define which vehicles are in the work gang, and/or which vehicles the CTU module/component should keep track of. It should also be understood that although the foregoing describes a CTU module/component, the CTU circuitry and technology may be incorporated into other modules, components and subcomponents of the VMM, such as the CEM. In some embodiments, the CTU module/component may be a software feature that is executed by a processor in the CEM.

[0046] VMM subcomponents (for example, the components included within the TSM, CEM and UIM) may be packaged together within a single enclosure. For example, in some embodiments, the CEM and UIM (and optionally, the CTU module) may be combined/disposed in a single package. One benefit of a single package may be that it simplifies the installation process. In alternate embodiments, or one or more VMM components and/or subcomponents may be packaged separately from the other components/subcomponents. The various components and/or subcomponents may be located separately, optionally within separate enclosures, and each separate component may be connected to a main VMM enclosure and/or to other VMM enclosures via wires or

a short range wireless link For example, wireless communications antenna **608** and/or one or more vehicle communication devices **612** may be mounted separately (optionally, in one or more enclosures) on the upper extremity of the vehicle, for example to reduce signal interference and to allow for proper antenna placement (see FIG. **8**). Likewise, the user interface **614** may be located in the crew area or the passenger cab. The number of physical packages/enclosures included in each VMM and the mounting location of each package/enclosure may depend on the type (height, length, etc.) of vehicle the VMM is mounted on, or may depend on the configuration of the VMM. In one example, all of the components of the vehicle mounted module are housed within a single weatherproof enclosure. In another example, the wireless communications antenna (for example, wireless communications antenna **608**) (or the entire wireless communications radio including the antenna) may be installed at a distance from other VMM enclosures/components to avoid interference between the wireless communications antenna and other components of the VMM, for example the UWB sensor.

[0047] FIG. **7** depicts an illustration of a block diagram of an example control electronics module (CEM) **700**, in accordance with one or more embodiments of the present disclosure. The CEM **700** may include a processor **702**, a wireless communications radio **704** (such as an RF radio), an interface to a TSM **730**, an interface to a UIM **720**, one or more interfaces **706** to ground speed detection modules, a power supply interface/power conditioning system **708**, and a real-time clock **714**. Examples of ground speed detection modules that may connect to interface **706** include an encoder module **750**, a microwave radar **752** and/or a laser device **754**. The interface to the UIM **720** may further include one or more drivers to power visual and/or audio indicators. In some embodiments, the CEM **700** may include one or more vehicular interfaces (interfaces to existing vehicle systems), for example a CAN interface, braking systems, speed indicators, equipment operating mode status indications and the like. The CEM **700** may include an inertial measurement unit **710** that includes one or more devices, for example, one or more accelerometers and/or gyroscopes. The CEM **700** may include a log/memory **712**.

[0048] It should be understood that although FIG. **7** depicts some or all of the aforementioned subcomponents as being contained within the CEM **700**, different configurations of the VMM are contemplated by this disclosure, including various combinations of VMM components/enclosures. Therefore, in some embodiments, the subcomponents depicted in FIG. **7** may be disposed outside of the CEM **700**, for example in one or more other VMM enclosures. And in other embodiments, subcomponents other than those depicted in FIG. **7** may be disposed inside of the CEM **700**, for example one or more subcomponents that may reside in other VMM enclosures in other embodiments. In some examples, some of the subcomponents depicted in FIG. **7** may reside in the UIM and/or the TSM and may connect to the CEM by way of wires or wireless connection(s).

[0049] Referring again to FIG. **7**, CEM **700** may include a processor **702**. The processor **702** may, among other operations, process information received from the vehicle communication devices, for example via the interface to the TSM **730**. For example processor **702** may be in communication with and process information from a UWB unit via TSM interface **730**. The processor **702** may also process information received from other modules, components and/or subcomponents of the VMM. The processor **702** may handle information and/or perform computations to, among other things, track other vehicles in a work gang and determine which vehicles present a potential hazard. It should be understood that the CTU may also process location and speed information from vehicles in a work gang and may also track vehicles in a work gang to determine when collisions may be imminent. The present disclosure contemplates various types of configurations whereby some or all of the tracking and processing components of the CAS may be located within the VMMs (for example, within a CTU module), within a CTU in a discrete housing, or a combination of both. In the example where a CTU module/component performs tracking of other vehicles, a CTU module **703** may be disposed within the CEM **700**, perhaps implemented in processor **702**. In some embodiments, the CTU module **703** may be a software feature that is executed by the CEM processor **702**.

[0050] CEM **700** may include an inertial measurement unit **710** that includes one or more devices, for example, one or more accelerometers and/or gyroscopes. The inertial measurement unit **710** may be operable to, among other functions, detect changes in the speed of a traveling vehicle. Detecting changes in vehicle speed may be useful to aid in dead reckoning solutions instead of or in conjunction with short range distance measurement sensors. For example, if a vehicle travelled into a tunnel and the GPS unit could not establish a connection to satellites to provide positioning information, an inertial measurement unit may provide information regarding whether vehicles in a work gang have changed speeds while in the tunnel. An inertial measurement unit **710** may also be operable to detect sudden changes in speed, for example indicating that a vehicle was involved in a collision, or perhaps indicating some other event. The inertial measurement unit **710** (or some other VMM component) may then store/log data regarding the activities of the vehicle (and/or VMM components) surrounding the time of the event, similar to the way a flight recorder records events proximate to a plane crash. This recording component may collect information from the inertial measurement unit **710** and/or from other VMM components, for example from a UWB unit.

[0051] CEM **700** may include a real-time clock **714**. The real-time clock **714** may provide accurate (optionally, synced) time readings, for example to facilitate development evaluation testing. The time and date of the real-time clock may be adjusted automatically, for example by receiving updates from a GPS unit via TSM interface **730**. The time and date of the real-time clock may be adjusted by receiving change requests from the service interface or user interface via UIM interface **720**. In one example, the real-time clock **714** may exhibit an accuracy of plus/minus 5 seconds per day at 25 degrees Celsius.

[0052] The CEM **700** may be mounted in or near the vehicle cab. For example, if the CEM **700** is packaged with a UIM, the CEM may be mounted in the cab near an operator. In other examples, the CEM may be mounted on an upper frame or part of the vehicle, for example within the vicinity of the TSM. For example, if the CEM is packaged with one or more components of the TSM, a higher mounting location may reduce interference for TSM modules, for example the GPS unit and/or UWB unit. The CEM may be packaged with the TSM in shorter vehicles for example. In some embodiments, it may be beneficial to package the CEM separately from the TSM. In one particular example, the CEM may be mounted

directly below the TSM, were the TSM is disposed above or on the roof of the vehicle (see FIG. **8**) and the CEM is disposed below the roof of the vehicle, for example fixed to the inner ceiling of the vehicle. In this example, the CEM may be sheltered from direct exposure to sunlight and the components of the TSM may experience minimal interference and a clear line of sight.

[0053] The CEM **700** may interface (for example via a power supply interface **708**) with a power supply **760**. The power supply interface **708** may include a power conditioning system. In one example, all power for the VMM components and subcomponents passes through the power supply interface/conditioning system **708** located in the CEM, and then power for the other VMM components is routed out from the CEM. In other examples, one or more VMM components may include their own power conditioning systems and may accept power from a power supply without receiving power that is channeled through the CEM. The power supply may be the same as the vehicle's power supply, for example a 12 VDC or 24 VDC power supply. Alternatively or in addition, the VMM may include an independent power supply such as a battery, solar panels, and the like.

[0054] Referring again to FIG. **6**, VMM **600** may include a transponder sensor module (TSM) **604**. In some implementations of the VMM, one or more components of the TSM **604** may be packaged with the CEM **602**. In other implementations, it may be beneficial to package one or more TSM components separately from other VMM components, for example on an upper extremity of a vehicle. FIG. **8** depicts an illustration of side angled view of the upper portion **802** of an example rail line vehicle (for example a vehicle similar to the vehicle of FIG. **1**C) and a mounting configuration **804** for one or more components of a TSM, in accordance with one or more embodiments of the present disclosure. One or more TSM components may be mounted at a high point (for example, the highest point) on the vehicle, where a clear line of sight may be established between the TSM components and an area to the front and rear of the vehicle.

[0055] In the example shown in FIG. **8**, the wireless communications antenna **806** (for example, similar to the wireless communications antenna **608** of FIG. **6**) and a UWB unit **808** (for example, similar to the UWB unit **620** included in the one or more vehicle communication devices **612** of FIG. **6**) may be mounted separately from other VMM enclosures. In this example, the wireless communications antenna **806** and UWB unit **808** may be mounted on the upper extremity **810** of the vehicle to reduce signal interference and to allow for proper antenna placement. It should be understood that FIG. **8** depicts only one example of TSM components that may be mounted on the upper extremity of a vehicle. More or less TSM components (or other VMM components) than are shown in FIG. **8** may be mounted on the upper extremity of a vehicle. For example, components that may be mounted on the upper extremity of a vehicle may include the UWB unit, wireless/RF antennas and/or radios, GPS units, infrared sensors and the like.

[0056] TSM components (and/or other VMM components) may be installed on the upper extremity of a vehicle by a variety of means. Referring to FIG. **8**, for example, a hole may be drilled through the side of an upper portion **802** of a vehicle or through the roof **810** to allow hardware to thread through the vehicle's upper portion **802** and also through VMM components to fix the components to the upper portion. Additionally, brackets, flanges, sockets or other hardware may be used to fix components to the upper portion **802**. For example, FIG. **8** shows a bracket **814** that may be used to fix a UWB unit to the upper portion **802**. The bracket **814** may be fixed to the upper portion **802** of a vehicle and the UWB unit may be fixed to the bracket. Brackets may aid in attaching components to the upper portion **802**, and/or they may elevate components so that the components experience increased line of sight and decreased interference. One or more holes may be drilled through the roof **810** or a side wall of upper portion **802** to allow the passage of interface cables (for example, cable(s) **812** of FIG. **8**) into and/or out of the cab of a vehicle.

[0057] FIG. **9** depicts an illustration of an example rail line vehicle **900**, including a VMM that includes more than one TSM, in accordance with one or more embodiments of the present disclosure. In some embodiments of the disclosure, the VMM in a rail line vehicle may include more than one TSM, or may include more than one group of TSM components mounted on the upper extremity of a vehicle. With regard to the disclosure herein, when a description explains the configuration and/or benefits of multiple TSMs, it should be understood that the entire TSM may not be duplicated. Instead, one or more components of the TSM may be duplicated, while there may be a single instance of other components of the TSM. For example, the VMM may include duplicated vehicle communication devices, such as two or more UWB units. Additionally, while the disclosure herein may describe two TSMs, some embodiments may include VMMs with more than two TSMs.

[0058] Referring to FIG. **9**, a VMM installed in a vehicle **900** may include two TSMs **902**, **904** (or two groups of some TSM components), for example mounted at either end of the vehicle **900**. As shown in the example of FIG. **9**, the two TSMs **902**, **904** may be mounted at the extreme (or near extreme) front and rear ends of the vehicle **900**. Placing sensors, for example sensors included in TSMs **902**, **904**, at the extreme ends of a vehicle may improve the accuracy of some sensors, for example sensors that measure distance between vehicles (such as UWB sensors or infrared sensors). Especially if the vehicle **900** is long, a distance sensor (for example a sensor included in TSM **904**) that is placed near the end of a vehicle may more accurately calibrate itself to determine the exact location of the end of the vehicle **900**, and thus the sensor may be able to determine more accurately the distance between the end of the vehicle **900** and other vehicles. The two TSMs **902**, **904** may be connected to a single CEM **906**, which may be connected to a single UIM **908**. In other embodiments, the VMM may include more than one CEM and/or more than one UIM.

[0059] When a VMM-equipped vehicle is initialized to operate with a CAS, the VMM components of the vehicle may be calibrated (also referred to as "commissioning" the vehicle) to the particular installation configuration for that vehicle. Calibration may include an operator specifying the vehicle length in each direction from the one or more mounted TSMs. Rail line vehicles (for example, maintenance vehicles) can range in length (see FIG. **1**), for example from 12 feet to 80 feet, and the vehicles can have a variety of cab locations and configurations. Given the different lengths and configurations of vehicles, it may be necessary to program information into various components of the VMM, including the TSM and/or the CEM, such that the components are aware of (and/or can compute) the distance between the component's mounting location and the ends of the vehicle.

[0060] In some embodiments of the disclosure, circuitry within the VMM (for example in the CEM) may automatically compensate (calibrate) for the length of the vehicle and the mounting location. In one example, the VMM may include a single TSM, and the TSM may be mounted on the vehicle (for example, at the front or center of the vehicle), and circuitry within the VMM (for example in the CEM) may automatically compensating for the length of the vehicle and the mounting location. In another example, the VMM may include multiple TSMs, and the TSMs may be mounted on the vehicle (for example, near the front and rear of the vehicle), and circuitry within the VMM (for example in the CEM) may automatically compensating for the length of the vehicle and the mounting location of the multiple VMMs. The sensors may be designed to adjust for the size of the equipment and specific location of the components. The present disclosure contemplates various methods and solutions to adjust settings of VMM's components at initial installation to aid in component awareness. Components may contain smart technology that aids in the component's calibration. The VMM components may also be operable to account for a length of a vehicle that may change on the fly. For example, some vehicles change length when retractable sections are extended. The VMM components may be designed to accommodate this change in length, either by manual user input or automatic detection of the vehicle configuration.

[0061] Referring again to FIG. **6**, the TSM **604** may include one or more vehicle communication devices **612**. It should be understood that throughout this disclosure, when reference is made to vehicle communication devices, there may only exist a single vehicle communication device, for example just a UWB unit. In other examples, there may be more than one vehicle communication device. Vehicle communication devices **612** may be packaged together, or they may be packaged independently, or they may be packaged with other TSM components. The vehicle communication devices **612** may be in close communication with the CEM **602** via either a wired connection or a short range wireless connection. One benefit of a wired connection is that the CEM, which may contain a power conditioner unit and an interface to a power supply, can provide power to the vehicle communication devices, along with communication functions.

[0062] The vehicle communication devices **612** may communicate wirelessly with other CAS/VMM-vehicles **638** in the work gang. The vehicle communication devices **612** may be operable to, among other functions, determine the relative location of other CAS/VMM-equipped vehicles in relation to the present vehicle. The vehicle communication devices **612** may utilize one or more communication technologies and may include one or more integrated antennas for sending and receiving signals to and from other vehicles. In one example, each vehicle may have a unique identification code that was assigned when the VMM was installed in the vehicle, or before or after such installation.

[0063] In some embodiments of the present disclosure, the vehicle communication devices **612** may include an Ultra Wideband (UWB) unit **620** to communicate with other VMMs. In one specific example, the UWB unit **620** is the only vehicle communication device. The UWB unit may include a control board, a data interface and/or a UWB antenna. The UWB unit **620** is typically adapted for sending signals to and/or receiving signals from UWB units mounted on/inside other vehicles. The UWB unit **620** may be adapted to measure the relative separation distance between properly equipped vehicles without becoming confused by interference from nearby stationary or unrelated off-track equipment that might otherwise cause false alarms in radar-based collision avoidance systems.

[0064] FIG. **10** depicts a block diagram illustrating example UWB units, in accordance with one or more embodiments of the present disclosure. Pulses emitted from a UWB transmitter may spread in many directions. A UWB unit may transmit and receive pulses that are communicated directly **1002** between UWB units (for example between a UWB transmitter/transceiver **1008** and a UWB receiver/transceiver **1006**), and/or the UWB unit may transmit and receive pulses that have been reflected **1004** (bounced) off of an object and/or surface, for example the ground. A UWB unit may be capable of resolving multipath reflections from a main signal by focusing on the first arriving pulse. Additionally, the UWB technology may take advantage of the fact that radio waves/pulses travel at a particular velocity. By measuring how long it takes a wave/pulse to travel (for example by reflecting/bouncing) between two transceivers, the distance between the UWB units can be accurately determined. This technique may be referred to as "Time of Flight" (TOF). In existing wireless radio technologies, TOF calculations have previously had limitations due to the reflection of radio waves from the wide range of objects in the vicinity. These reflections may result in the receipt of numerous conflicting signals of varying amplitudes, and in some instances one or more signals may cancel each other out, a phenomena referred to as "multi-path distortion". This may result in inaccurate distance determinations because a direct wave may have been cancelled out, and a reflected wave may travel a longer path and appear to be the first arriving pulse, resulting in a false (longer than actual) separation distance measurement.

[0065] A UWB unit may utilize a high bandwidth pulsed distance-measurement technology. A UWB transceiver may utilize a broad spectrum of frequencies simultaneously at a relatively low power levels. A UWB unit may be operable to periodically transmit short duration pulses, such as RF pulses. For example, a UWB unit may measure a distance of several hundred feet with a resolution of several inches. Precise range determination may be advantageous, for example when vehicle separations are small and/or when a potential GPS measurement error becomes significant. In one example, a GPS measurement error may be 10-15 feet. Additionally, each pulse transmitted by a UWB unit may be coded and the phase of the pulse may be modulated and the pulse repetition rate may be variable. Thus, a UWB unit may measure separation distances more accurately and be less susceptible to interference from geographic conditions and less susceptible to multi-path distortion than are other wireless technologies.

[0066] A UWB unit may transmit one or more signals that may be pseudo-randomly (and uniquely) encoded with low-amplitude RF energy spread over a 2 GHz bandwidth. The transmitted signal may be spread out over such a wide range of frequencies that the transmissions appear like normal background atmospheric noise. As a result, the signal is unlikely to cause interference with other communications systems. This encoding also means that information may be transmitted with the range finding signal, such that data communication may be accomplished while distance measurement is performed. In other words, the UWB unit may be adapted to transmit data to other UWB units in addition to detecting the distance to other UWB units. In effect, the two functions (data and distance) may be performed at the same

time using the same wireless link because the UWB unit may transmit data, and then additionally, distance information may be computed by determine how long it took for the data to travel from one UWB unit to the other. It should be understood, however, that the two functions (data and distance) need not be performed at the same time.

[0067] The UWB unit may be adapted to send data as well as determine distance between vehicles. Because the UWB unit may be utilized to send data, some embodiments of the present disclosure, for example those where a central tracking component resides in the vehicle mounted module, may not need to use any other type of wireless or RF technology to communicate. This could reduce the technology components required in the system, reducing cost of the system. However, in other embodiments, a VMM may benefit by utilizing more than one data link (wireless technology capable of transmitting data). For example, a wireless RF link may provide a greater distance/range for sending data than a UWB unit, and because of this benefit and potentially other benefits of various types of data links/wireless technologies, a VMM may benefit by utilizing more than one type of data link Additionally, a collision avoidance system may have multiple data links in order to introduce redundancy into the system. For example, the UWB unit may be capable of sending data if the RF link is not functioning properly, and vice versa.

[0068] One example of a UWB technology that the CAS may utilize is the technology described in the White Paper published by Time Domain entitled "Time Domain's Ultra Wideband (UWB): Definition and Advantages," which is incorporated by reference in its entirety herein. However, it should be understood that the collision avoidance system may utilize other designs and types of UWB technologies besides just the one described in the White Paper.

[0069] The UWB unit may be operable to measuring the vehicle separation independently. Thus, in various embodiments of the CAS, the UWB unit may replace the GPS unit, or the UWB unit may work in conjunction with the GPS unit. As explained above, the CAS may be designed to include redundancy in the system, for example in the form of multiple types of sensor technologies and/or multiple sensors of a particular type of technology. One benefit of utilizing redundant sensors may be that some sensors may function properly when other sensors are not functioning optimally or at all. For example, a GPS sensor may not communicate well with satellites when a vehicle is in a tunnel, and thus the GPS unit may not provide adequate information to the CAS in this situation. However, in this situation, the UWB unit (or other sensors/technologies) may be fully functional. For example, tests have been performed in tunnels that stretch up to 1 mile in length (or longer), and the tests have shown that a properly configured UWB unit may accurately measure distance and relative speed of vehicles in such a tunnel. UWB sensors (and/or other non-GPS type sensors) may also work in conjunction with a GPS sensor. For example, a UWB sensor may provide better resolution (i.e., can measure separation distance at finer increments, more accurately) and the GPS sensor may provide a location/separation information over a greater area.

[0070] Referring again to FIG. **6**, once a UWB unit determines distance information, it may communicate this data to a CTU **630**, for example via wireless communications antenna **608**. Wireless communications antenna **608** may be an RF antenna, for example a 2.4 GHz radio antenna. In other embodiments, where there is no CTU in a discrete housing, UWB distance data (an optionally other data) may be communicated to CTU modules in other VMMs via wireless communications antenna **608** and/or a separate wireless communications antenna located in the TSM **604**. In embodiments where the UWB unit is adapted to operate in conjunction with a GPS unit, combined GPS and UWB distance data may be communicated between a vehicle and the CTU **630** and/or between vehicles in the work group via similar wireless communications antennas/technologies as described herein.

[0071] FIG. **11** depicts and illustration of a side view of an example rail line vehicle including multiple UWB units (or multiple UWB components), in accordance with one or more embodiments of the present disclosure. In some embodiments, a VMM installed on a vehicle **1102** may include more than one UWB unit (for example, UWB units **1104**, **1106**), for example to introduce redundancy into the system. In some embodiments, a VMM installed on a vehicle **1102** may include more than one UWB antenna, and the multiple UWB antennas may share a common control board and/or data interface. When present disclosure describes multiple UWB units, it should be understood that the entire UWB unit may be duplicated or one or more components of the UWB unit may be duplicated, for example the UWB antenna. In some embodiments, multiple UWB units (or multiple UWB components) may be housed in a single enclosure. In other embodiments, multiple UWB units (or multiple UWB components) may be housed in separate enclosures, as depicted in FIG. **11**.

[0072] In some situations, when a UWB pulse is reflected from an object or a surface (for example the ground), the UWB pulse may be destroyed (for example, by a reflected signal which is the same amplitude but **180** degrees out of phase) or altered before it gets to the UWB receiver, and/or other interference may cancel out a pulse. These situations where a UWB link might not transmit a pulse ideally may be referred to as "holes." In some embodiments, the VMMs may include more than one UWB unit (or UWB component), for example in case one UWB pulse is destroyed. In some examples, two UWB units (or two UWB antennas) may be mounted on a single vehicle with a small offset between the UWB antennas. For example, referring to FIG. **11**, two UWB units (or two UWB antennas) **1104**, **1106** may be mounted on a single vehicle **1102** with a small vertical distance **1108** between the UWB antennas. In this example, pulses **1110**, **1112** from the two UWB units **1104**, **1106** (respectively) may arrive at a UWB receiver of another vehicle after traveling slightly different distances (for example, because they reflected off the ground at different angles). Multiple/redundant UWB units may increase the probability that whatever surface and/or interference destroyed or altered one UWB pulse will not interfere with the second UWB pulse. In some examples, two UWB units (or two UWB antennas) may be mounted on a single vehicle with a small horizontal distance between the UWB antennas. The horizontal offset may provide information to the VMM to determine the orientation of nearby vehicles in relation to the immediate vehicle. For example, UWB unit information may show that a nearby/target vehicle that is in front of the immediate vehicle is closer to a front UWB antenna, and likewise for a rear vehicle/rear UWB antenna.

[0073] In some embodiments, one or more UWB units may be operable to transmit/receive signals with varying center frequencies. This multiple center frequency technique may work with a single UWB unit or it may work with multiple

UWB units. In a single UWB unit example, the UWB controller may utilize adaptive output filters. The UWB unit may include a single UWB transceiver that is adapted to send multiple pulses/signals with different center frequencies at different times, for example alternating between modes (center frequencies). A corresponding UWB receiving unit may be synchronized with the UWB unit sending the signals, in that it may receive pulses/signals with different center frequencies at different times. In a multiple UWB unit example, one UWB unit may send signals at one center frequency and another UWB unit may send signals at a different center frequency. Variations in the center frequency of the UWB signals may result in a different phase delays of the signals, for example when reflected. If one signal has been significantly altered or destroyed by a reflection, another signal(s) (which utilizes a different center frequency) may be unaffected, or at least less affected, by the reflection. This may be because different frequency signal(s) over the same reflection path length may experience a different phase delay. This approach may improve the reliability of UWB communications under certain operating conditions.

[0074] Referring to FIG. **6**, in some embodiments, the vehicle communication devices **612** may include other wireless communication devices/technologies (beyond or in replacement of a UWB unit) to communicate with other VMMs. In some embodiments, a VMM may utilize a wireless communications antenna/radio (for example, an RF antenna/radio) to communicate with other VMMs. In some embodiments, the same wireless communications antenna **608** that communicates with a CTU **630** may communicate with other VMMs. In some embodiments, the vehicle communication devices **612** may include an ultrasonic or short distance laser device. Some example ultrasonic or short distance laser devices can sense distances between zero and thirty feet. In yet other examples, the vehicle communication devices may utilize radar, infrared (IR), and/or optics technologies.

[0075] Referring again to FIG. **6**, a TSM may include a Global Positioning System (GPS) unit **610**. The GPS unit **610** may be incorporated to the TSM. In some embodiments, the GPS unit **610** may be packaged with one or more vehicle communication devices **612**, or it may be packaged in the CEM. Alternatively, the GPS unit **610** may be housed separately or may be incorporated into other VMM components or subcomponents. The GPS unit may include either an integrated or separate antenna assembly.

[0076] The GPS unit **610** may be adapted to determine the absolute position and speed of a vehicle that is equipped with the GPS unit. Information/data generated by a GPS unit may allow real-time determination of vehicle velocity and location. This information/data may allow a GPS unit **610** to determine expected vehicle stopping distances and may enable logging of equipment location with respect to time and date. For example, absolute location information provided by a GPS unit **610** may be useful to track the work performed by a work gang. A GPS unit may also provide distance information regarding the distance between two GPS-equipped vehicles.

[0077] Some GPS-based systems may experience reduced accuracy at times or may lose all connection with satellites, for example, when a vehicle enters a deep valley or a tunnel. A GPS unit may provide distance information in conjunction with other technologies that provide distance information (for example, UWB, infrared) as a form of redundancy and/or to offer a variety of distance measurement ranges and precision. A GPS unit may be operable to determine vehicle position within a wider range, for example 10 to 15 feet. A GPS unit may allow for the determination of distances between vehicles that are too far apart for other types of distance detection technologies to function accurately. Then, other technologies, for example a UWB unit, may provide a more precise distance measurement, for example a distance within 6 inches. The accuracy of a GPS unit **610** may be enhanced by utilizing a WAAS (Wide Area Augmentation System), a system of ground reference stations across North America that provide GPS signal corrections. Corrections provided by a WAAS may improve the positioning capability of the GPS unit **610**, for example by a factor of five, such that the location may be determined as accurately as within 2 to 3 feet.

[0078] Referring to FIG. **6**, the VMM may include one or more user interface modules (UIM) **606**. A UIM **606** may further include a user interface **614**, a service interface **616** (optionally with diagnostic components/interfaces) and status/fault indicators **618**. A UIM **606** may provide an operator with an interface by which the operator can engage with the technologies that are part of the VMM, and by which the operator may be alerted of events, for example if vehicle separation criteria are violated. A UIM may be located/mounted within convenient reach and view of the operator, and may be connected by an interface cable (or short range wireless connection) to other VMM modules, for example the CEM. For example, the UIM may be mounted in a vehicle cab in order to allow the operator to see and hear warning and alarm indications.

[0079] Status/fault indicators **618** may alert an operator that one or more VMM components and/or subcomponents are not operating in an optimal manner. In some embodiments of the present disclosure, the VMM components may be operable to "self-monitor," meaning they may be adapted to monitor their own operation and health. If a VMM detects degraded or non-optimal performance (for example regarding any of the sensors or other VMM components or subcomponents), the status/fault indicators **618** may alert an operator. In some embodiments, the VMM may communicate status/fault indication to the CTU (or CTU module(s), for example via a wireless communications antenna, for example wireless communications antenna **608**.

[0080] FIGS. **12**A and **12**B depict illustrations of example user interfaces, in accordance with one or more embodiments of the present disclosure. The UIM may include a user interface. Referring to FIGS. **12**A and **12**B, it can be seen that a user interface (for example user interfaces **1202**, **1204**) may include one or more means of alerting an operator of events, for example if vehicle separation criteria are violated. FIG. **12**A shows one example of a user interface **1202**. In this example, the user interface **1202** may include one or more visual indicators **1206**, one or more audible indicators **1208**, one or more switches/buttons **1210**, **1212**, **1214**, and/or other input means or alerting means. Examples of visual indicators **1206** are lights, lamps, alpha-numeric character displays, LED's and the like. These indicators may provide an operator with information regarding the technologies included in the VMM, and certain indicators may alert the operator when an event occurs, for example when separation parameters (between vehicles for example) are exceeded. Examples of audible indicators **1208** are variable characteristic audible indicators, buzzers, alarms, sirens, horns and the like. The user interface **1202** may include one or more interface switches/buttons **1210**, **1212**, **1214** that may be adapted to

allow an operator to configure and/or interact with components of the VMM. For example switches may be adapted to activate and deactivate component interfaces, for example component interfaces in the CEM. In one example, (and referring to FIG. 7), an operator may use a switch to deactivate the interface **706** to an encoder module. Examples of other input switches/buttons are buttons that acknowledge (temporary mute) a buzzer, alarm or a horn.

[0081] FIG. 12B shows another example of a user interface **1204**. The user interface **1204** may be a touchscreen, tablet, PDA, monitor or other type of digital display/interface. Even though some descriptions of user interface **1204** may refer to it as a touchscreen, it should be understood that other alternatives mentioned and others may be contemplated. In some embodiments, a touchscreen may be implemented in conjunction with other types of user interfaces or user interface components, for example the components of user interface **1202**. In some embodiments, a touchscreen may be adapted to serve as the only user interface component that interfaces with the operator. In some embodiments (and referring to FIG. 6), if a touchscreen is used to implement the user interface **614**, other components of the UIM (for example the service interface **616** and/or the status/fault indicators **618**) may be incorporated into the same touchscreen.

[0082] User interface/touchscreen **1204** may offer more flexibility and functionality than "hard" switches, lights, buzzers and the like. For example, a touchscreen may include on or more physical buttons (for example button **1218**), but may also allow an operator to engage "soft"/temporary buttons on the screen **1216** of the touchscreen. In this respect, the touchscreen may offer similar functionality to hard switches/buttons. Additionally, a touchscreen may include one or more speakers and/or audio drivers, and thus the touchscreen may offer similar functionality to hard buzzers, alarms and the like. The screen **1216** of the touchscreen **1204** may also alert an operator to an event, offering similar functionally to hard lights, lamps and the like.

[0083] A touchscreen **1204** may be adapted (i.e., programmed, etc.) to display to an operator multiple sets of screens and/or menus, with multiple sets of options, functions and the like. Additionally, a touchscreen may be adapted to display complex (for example, graphical, textual, etc.) information to an operator. For example, a touchscreen may show the operator the speed of his vehicle, or may show operator his GPS coordinates. A touchscreen **1204** may be adapted (i.e., programmed, etc.) to offer additional functionality, for example allowing operators to send messages (for example text-based or html-based message) to nearby vehicles. In some embodiments, a touchscreen may provide a GPS-augmentation feature, for example, which may adapt the touchscreen to display the location of the vehicle relative to railroad mile markers.

[0084] It should be understood that the components and/or functionalities of user interfaces **1202** and **1204** may be incorporated into or implemented in one or more physical housings and/or devices. These components may be incorporated into discrete enclosure(s) (for example mounted near an operator/cab) and/or they may be incorporated into VMM components. In some embodiments, the user interface (for example, interfaces **1202** and/or **1204**) may be mounted alongside or in the same enclosure as the CEM **1230** or it may be mounted in a separate enclosure. For example, the user interface may be located in the passenger cab and the CEM may be located on an upper internal extremity of the vehicle. This flexible mounting arrangement may help to accommodate a wide range of equipment/vehicles that the CAS may need to track by allowing the user interface to be mounted where it is visible and accessible to the equipment operator while allowing the CEM to be mounted in close proximity to the TSM, which may improve performance, for example by allowing better reception.

[0085] The user interface (for example user interfaces **1202** and/or **1204**) may be in communication with the CEM **1230**, and/or other VMM modules. The user interface may communicate with the CEM, for example, via either a wired interface or a short range wireless connection. One benefit of a wired connection is that the CEM, may contain a power supply interface and/or a power conditioner unit and may be able to provide power to the user interfaces, along with communication functions.

[0086] Referring to FIG. 6, the UIM **606** may include a service interface **616** that provides for installation, configuration, maintenance and/or diagnostic activities. The service interface **616** may be incorporated as part of the user interface, or it may be housed separately. In some embodiments, the service interface **616** may be located in the CEM **602**. The service interface **616** may also be used to initialize the vehicle mounted module. In other embodiments, the user interface **614** may be used to initialize the vehicle mounted module. For example, the CEM may include a setup program that initializes the various VMM components and subcomponents. An operator may use the user interface **614** or the service interface **616** to input initialization information into the setup program. Such information may include the physical location where various VMM components are mounted on the vehicle, as well as vehicle size and vehicle type. This information may be input when the vehicle mounted module is initially installed on the vehicle.

[0087] The service interface **616** may include a variety of technologies that may enable fast and easy communication between an operator and the service interface, and between the service interface and other VMM components and subcomponents. For example, service interface **616** may include one or more USB ports, Ethernet ports, and/or SD memory card slots. Service interface **616** may be configured, for example, with an industry standard Ethernet port to allow the use of commercially available laptop computers that may interface with service interface **616**, for example to perform status inquiries, to configure settings of VMM components, and/or to update the software/firmware of VMM components. Ethernet ports generally will conform to the IEEE 802.3 communication standard for 10BASE-T Ethernet (or alternatively 100BASE-T). In addition to Ethernet ports, or in conjunction with Ethernet ports, the service interface **616** may be configured with an 8-position RJ45 modular jack for interconnection. The service interface **616** may also operate as a DHCP server, thus allowing an operator to connect a laptop to the Ethernet port and within a few seconds be automatically configured and communicating with the VMM **600**. Alternatively, the service interface **616** may require a static IP address setting to be configured on the laptop. In such a configuration, the service interface may conform to the Internet Protocol Version 4 (IPv4). In some examples, the service interface connectors, such as the Ethernet connectors and the RJ45 connectors, may include environmental dust shields for protection.

[0088] In some embodiments, service interface **616** may include wireless capabilities. For example, service interface

616 may include a wireless radio (for example an RF radio), WIFI components and/or other wireless technology. A service interface 616 with wireless capabilities may be adapted to accept "field updates." Field updates refer to updates to the software and/or firmware of VMM modules that are "pushed" to the modules over a wireless link In one example, a foreman may drive up to a group of vehicles and may push updates to all the vehicles simultaneously, for example without having to physically connect to the vehicles. Alternatively or in addition, wireless communications antenna 608 (and/or other wireless communication antenna(s)) may be used to perform field updates.

[0089] In one or more embodiments of the present disclosure, the VMM may include (or may interface with) one or more non-GPS type sensors. These non-GPS type sensors may be adapted to measure speed (also referred to as ground speed) and direction of a rail vehicle. A GPS unit may provide speed and direction information, but in some embodiments and/or in some situations, the non-GPS type sensors may either supplement or replace GPS speed and direction information. For example, non-GPS type sensors may supplement a GPS sensor as a form of redundancy in the system, or may provide speed and direction information when the GPS unit cannot communicate with satellites (for example, when a vehicle is inside a tunnel). Additionally, these non-GPS type sensors may allow the CAS to determine relative vehicle position. For example, the non-GPS type sensors may calculate relative vehicle position as a function of the offset from the last known GPS location.

[0090] One type of non-GPS type sensor is an encoder module. An encoder module may be adapted to measure ground speed and direction of a rail line vehicle. The encoder module may supplement the UWB technology or replace the UWB technology, for example as a method of providing more precise "dead reckoning" data to the CAS, helping to overcome the "dead reckoning" limitations of earlier systems. In one embodiment, the encoder module may include a small rubber wheel which contacts the top of a rail on which the vehicle travels. The encoder module may be mounted on an adjustable preloaded assembly which maintains contact with the rail. A magnetic rotary encoder may count the rotations of the wheel. In one example, an encoder module may use a small integrated Hall-ASIC to determine the rotational speed of the wheel. This wheel rotation information may be translated into distance information which may be communicated to a CEM either through a wired or wireless connection.

[0091] The encoder module may be adapted to allow the encoder assembly be manually or automatically raised from the tracks for maintenance or lifting of the vehicle from the tracks. The encoder module may also include auto calibration features. For example, as the encoder wheel turns, it may utilize GPS data, when it is available, to review the last distance traveled, and compare that with the number of rotations of the wheel. This information can be constantly updated and used to compensate for wheel wear and or track slippage. Referring to FIG. 7, a CEM 700 may include one or more interfaces such that a VMM may communicate with one or more non-GPS type sensors. An encoder module, for example, may be in communication with a CEM, typically connected to a module interface. As an example, FIG. 7 depicts an encoder module 750 connecting to a CEM 700 via an interface 706.

[0092] Another type of non-GPS type sensor that may be in communication with a VMM is microwave radar, for example a Doppler radar. A microwave radar may be adapted to measure ground speed and direction of a rail vehicle. In one example, a microwave radar may be mounted on a rail line vehicle and may be oriented to point at the ground to detect ground speed and direction of travel. A microwave radar, for example, may be in communication with a CEM, typically connected to a module interface. As an example, FIG. 7 depicts a microwave radar 752 connecting to a CEM 700 via an interface 706.

[0093] Another type of non-GPS type sensor that may be in communication with a VMM is a laser device. A laser device may be adapted to measure ground speed and direction of a rail vehicle. In one example, laser device may be mounted on a rail line vehicle and may be oriented to point at the ground. A laser device may bounce a signal off of the ground (or other stationary object) to detect ground speed and direction of travel. A laser device, for example, may be in communication with a CEM, typically connected to a module interface. As an example, FIG. 7 depicts a laser device 754 connecting to a CEM 700 via an interface 706.

[0094] Other types of non-GPS sensors that may be used in conjunction with the GPS sensor to detect ground speed and direction of travel include infrared sensors, UWB sensors as described herein, UWB radar sensors, and other types of radar sensors. These non-GPS type sensors may add redundancy to the GPS sensor, or they may provide information when GPS information is temporarily unavailable. One or more parts of one or more of the non-GPS type sensors may be packaged in the same enclosure as other VMM modules, or they may be packaged separately.

[0095] In operation, the CAS may be capable of precisely tracking the location and separation distances of vehicles equipped with appropriate equipment and/or components as described herein. When the CAS is tracking vehicles, a particular work gang may be operating in one of two modes for example—travel mode or work mode. For each mode, railroad companies may require that a specific spacing be maintained between vehicles. In work mode, the vehicles may be traveling at a speed of less than 10 MPH, and about 40 to 50 feet of spacing between vehicles may be required. In travel mode, the vehicles may be traveling at speeds of up to around 25 MPH, and about 300 feet to about 500 feet of spacing between vehicles may be required. Depending on the mode in which the vehicles are operating, the CAS may adjust its sensitivity and/or settings in order to better predict when collisions may be imminent.

[0096] For the CAS to operate optimally, each vehicle in a work gang may need to be equipped with a VMM. The VMMs mounted on/in the vehicles and the CTU may only be able to detect vehicles which are outfitted with a VMM. In one embodiment of the present disclosure, the

[0097] CAS requires that every vehicle in a work gang be equipped with a VMM. If all vehicles in a work gang are equipped with a VMM, the CAS may be adapted to eliminate false warnings which plague existing systems, such as radar-based systems.

[0098] FIG. 13 depicts a flow diagram 1300 that shows exemplary steps in the operation of a CAS, in accordance with one or more embodiments of the present disclosure. To explain the operation of a particular vehicle/VMM, the immediate vehicle/VMM may be referred to as the "host" and nearby vehicles/VMMs with which the host links/communicates may be referred to as "targets". It should be understood that when the functionality of a host in relation to targets is

explained, each target may also act as a host for the purposes of explaining how that target vehicle operates in relation to nearby vehicles.

[0099] Referring to FIG. **13**, at step **1302**, the host vehicle/VMM is powered up. This may be referred to as the initial start-up. The VMM may begin to operate whenever a vehicle's systems are powered up. At step **1304**, within a few seconds of initial startup, the host VMM may begin to automatically detect the existence of other vehicles/VMMs in the vicinity. For example, the host VMM may automatically activate one or more vehicle communication devices to search for/link with other vehicles (targets) both in front of the host vehicle and/or behind the host vehicle. The host may survey its surroundings to determine if there is any other VMM-type equipment nearby. At step **1306**, the host may determine which discovered targets, both in front and in back, are the closest and may sense/measure the actual separation distance between the closest target in front and the closest target in the back. In some embodiments, the host may sense and compute distances for vehicles beyond just the vehicles immediately to the front and back of the host. At step **1308**, the host VMM may continuously sense/calculate distances between the host vehicle and the target vehicles. In some embodiments, the host may sense and compute distances for vehicles beyond just the vehicles immediately to the front and back of the host.

[0100] At step **1310**, the host (and perhaps other target vehicles) may transmit location and speed information to the CTU, for example through the radio antenna. Additionally or alternatively, the host VMM may transmit (and/or receive) location and speed information, for example through one or more vehicle communication devices, to target vehicles/VMMs. At step **1312**, the CTU and/or CTU module inside the host VMM may calculate information, for example absolute and relative location of the vehicles in the work gang, speed and direction of vehicles, separation distances and/or safe distance violations. At step **1314**, if the CTU and/or host VMM determines that collision is imminent or prescribed safe distances are violated, the host VMM, for example via a user interface, may notify the operator. For example, if the speed and direction information violates preset separation criteria, one or more warning indicators and/or audible buzzers, alarms and the like will activate. Additionally, the host VMM may communicate the violation to the CTU, perhaps through the radio antenna. At step **1316**, if the separation violation has been resolved, for example by the movement of vehicles away from each other, the warning/notification indicator to the operator may silence, and the host may resume monitoring for other potential violations by continuously sensing nearby vehicles and computing separation distances (return to step **1308**).

[0101] FIG. **14** depicts a flow diagram **1400** that shows exemplary steps in the operation of a CAS, in accordance with one or more embodiments of the present disclosure. Specifically, flow diagram **1400** shows exemplary steps illustrating how a CAS may determine distances between vehicles. Each vehicle in a work gang may include a GPS unit as well as other sensor technologies such as UWB sensors.

[0102] At step **1402**, a host may utilize its GPS unit to determine its absolute location and speed (and perhaps direction of travel). At step **1404**, the host may determine that it would benefit from information from other non-GPS type sensors. For example, one or more vehicles in the work gang may become unable to utilize the vehicle's GPS unit. Vehicles may travel through tunnels, mountains and developed areas that include structures that may prevent or reduce the functionality of GPS-based technologies, resulting in the GPS signal being lost (the "dead reckoning" situation). In these types of situations, the host may determine that other types of sensors included in (or in communication with) the VMM may aid in determining the precise location of vehicles. Even if the GPS signal is not lost, these other types of sensors may be used to enhance the precision of the location information gathered with respect to a vehicle. At step **1406**, the host may utilize non-GPS sensors to determine relative location and speed information. The host may utilize one or more vehicle communication devices. For example, the UWB unit may determine separation distance and closing speed. The host may utilize components connected to the VMM via component interfaces. For example, a Doppler radar or encoder wheel may determine ground speed and direction of travel.

[0103] At step **1408**, the host VMM and/or the CTU may compute separation distances between the host and other vehicles. For example, the microprocessor in the CEM (a component of the VMM) may compute the separation distance between the host and adjacent vehicles. In one illustrative example, a maintenance vehicle (the host) is 40 feet long, and a TSM is installed 10 feet behind the front of the vehicle. Another maintenance vehicle (the target) is also 40 feet long, and a TSM is installed 30 forward from the back of the vehicle. If there is 50 feet between the front of the host vehicle and the rear of the target vehicle, the CAS will measure a distance between the TSMs of 90 feet (10 feet+50 feet+30 feet). The CAS may then perform calculations to compensate for the placement of the TSMs relative to the front and rear of the vehicles. For example, the CAS will subtract 10 feet and 30 feet (the respective distances between the each TSM and the relevant ends of the vehicle) and determine a separation distance of 50 feet (90 feet−10 feet−30 feet).

[0104] At step **1410**, the host VMM and/or the CTU may compare computed separation distances to prescribed (safe) separation distances for the given vehicle speed/size. At step **1412**, the host VMM and/or the CTU may determine whether a collision is imminent and whether an operator must be cautioned. The CAS may consider a variety of types of data and scenarios to determine if a collision is imminent. For example, a separation distance of 40 feet may be acceptable when vehicles are traveling at 5 miles per hour, but if the vehicles are traveling at 20 miles per hour, an unsafe condition may exists and the operator will be notified with an audible and visual alert. In another example, a vehicle that is far ahead may not pose a hazard, but one that is directly ahead, and moving slower than the host vehicle may be a potential collision hazard. In another example, two vehicles may have been creeping along the tracks at a separation distance of 100 feet, and then the vehicles speed up to reach another worksite. If the separation distance does not increase with the increase in speed, the CAS may sound a warning or alarm.

[0105] Using various combinations of technologies (UWB, encoder modules, radar, etc.), the CAS can monitor the precise relative location and speed of the vehicles in a work gang, and determine whether a predetermined separation distance has been violated. The CAS may notify, caution, and/or alarm vehicle operators and/or other railroad personnel (via audible and/or visual indicators) when the separation distances between rail line vehicles becomes less than a specified safe distance, which may indicated that a vehicle is approaching another vehicle and is within a separation distance which may

not be safe. The specified safe distance may be programmed by trained service technicians.

[0106] Instead of sounding a "hard" alarm through visual and audible alarms when a separation distance is violated, the CAS may utilize a "progressive" warning approach. In general, as the relative spacing between potential alarm events decreases, the collision avoidance system may increase the severity of the warning indication. For example, if a vehicle is on a collision course but has not yet reached a hard threshold, the collision avoidance system may initiate a "soft" alarm/notification initially, such as a short, quiet, visible-only or subdued alarm. The rate, frequency, prominence and/or severity of the alarm may then increase as the vehicles get closer to the hard alarm threshold (indicating a more critical threat condition).

[0107] The CAS may adjust its thresholds according to the speed of one or more vehicles. This feature may be referred to as an "adaptive threshold" feature. The adaptive threshold feature may allow for scaling of thresholds of the alarm/notification levels based upon the speed of the immediate vehicle and the relative speed of the immediate vehicle and a vehicle that may collide with the immediate vehicle. For example, when vehicles are traveling to a worksite, at a speed of about 25 miles per hour for example, the expected separation distance may be about 300 to about 500 feet. In a scenario where a vehicle is at a worksite, moving slowly, the expected separation distance may be smaller, for example about 40 to 50 feet. The relative vehicle speed determines how long we have to respond to the issue, and our vehicle speed determines how long the stopping distance will be, which is non-linear.

[0108] The CAS may also include an option, mode or switch whereby an operator or a railroad foreman can temporarily deactivate/silence (for example via a user interface) the separation warning/notification features of one or more vehicles. Once silenced, a warning/notification may not repeat until the vehicle separation has again exceeded prescribed safe distances, or, for example, the warning/notification may sound again after a defined period of time if the separation distance violation has not been improved. This silencing feature may allow for periodic, sanctioned violations of prescribed separation distances without alarms, buzzers and the like becoming a nuisance to the operators. An operator may simply acknowledge that the violation of the separation distance was deliberate and the notification may not repeat, until another violation occurs for example. If the violation is not acknowledged, the notification/alarm may repeat periodically.

[0109] In some situations, for example, a vehicle operator may be asked by his foreman to temporarily violate the prescribed work separation distances, such as when vehicles come together for a meeting. In this situation, vehicles will slowly approach other vehicles and stop close to other vehicles, so that the work gang may be in a tight group. The operators can then dismount and walk a short distance for a meeting. The collision avoidance system may be designed to accommodate this tight-group situation without needlessly activating alarms, annoying railroad personnel and causing nuisance false alarms, for example by detecting very slow-speed approaches. In some examples, a deactivation may require an operator or a foreman to use a key, code, password or the like to gain authorization to deactivate the warning features. This will prevent an accidental or unauthorized deactivation that may lead to an accident where no warning was sounded. In other examples, the collision avoidance system may automatically reactivate the separation warning features after a certain amount of time, or when the vehicles separate a certain distance (or satisfy a certain distance/speed ratio), so that the system remains in an active tracking and warning mode when the vehicles are working or traveling.

[0110] FIG. **15** depicts a flow diagram **1500** that shows exemplary steps in the operation of a CAS, in accordance with one or more embodiments of the present disclosure. Specifically, flow diagram **1500** shows exemplary steps in the operation of a progressive/graduated warning system. In some embodiments, the CAS may utilize a progressive/graduated warning approach that utilizes classes of warnings and/or notifications. The CAS may start by initiating one class of warning, and then escalate to a more severe class of warning if certain distance/speed measurements violate certain thresholds. Separation distances for progressive/graduated thresholds may be based upon vehicle stopping distance test results as explained elsewhere herein. With regard to the following descriptions, it should be understood that a reference to the CAS or the VMM or the CTU performing a calculation, making a determination, generating a warning/alarm, or other events may actually be performed and/or generated by one or more components within the CAS, VMM and/or CTU.

[0111] At step **1502**, the CAS system may determine that a certain distance/speed measurements violate one or more certain preliminary thresholds. At step **1504**, the CAS generates a first class of warning. In one example, the first class of warning may be labeled as a "notification." In certain situations, it may not be dangerous to violate preliminary thresholds (for example, in the case of work vehicles congregating for a meeting), and thus notifications may be designed to allow operators to ignore/silence them. At step **1506**, the CAS may accept input from an operator regarding whether the operator wants to silence the notification. For example, an operator could indicate an "acknowledge" choice via a button, touch screen or the like. At step **1508**, if the operator chooses to silence/acknowledge the notification, this may silence the notification once, at least until a violation that leads to a notification reoccurs. Notifications may be auto ignored in certain situations, for example, if vehicles are moving very slowly. Notifications may be less prominent than other classes of warnings. For example, notifications may display on a screen on the user interface, and may initiate a short sound, without being too annoying or distracting to the operator.

[0112] At step **1510**, the CAS system may determine that a certain distance/speed measurements violate certain intermediate thresholds, thresholds that the CAS system has determined present a higher risk of collision. At step **1512**, the CAS may generate a second class of warning. In one example, the second class of warning may be labeled as a "caution" warning. In certain situations, it may not be dangerous to violate these intermediate thresholds, at least momentarily, and thus notifications may be designed to allow operators to ignore/silence them momentarily. At step **1514**, the CAS may accept input from an operator regarding whether the operator wants to silence the caution. At step **1516**, silenced caution warnings may reinitiate quickly if silenced, unless the situation that led to the caution warning is remedied. Caution warnings may be more prominent than notifications but may be less prominent than other more severe classes of warnings. For example, caution warnings may display on a screen on the user interface in a more prominent manner than notifications, such as by blinking, taking up more of the user interface

screen, etc. Caution warnings may initiate a louder sound than notifications, but may be designed to avoid being too annoying or distracting to the operator.

[0113] At step **1518**, the CAS system may determine that certain distance/speed measurements violate certain critical thresholds, thresholds that the CAS system has determined present a high risk of collision and require immediate correction. At step **1520**, the CAS may generate a third class of warning. In one example, the third class of warning may be labeled as an "alarm" warning. In certain situations, it may be dangerous to violate these critical thresholds, and thus alarms may be designed to prevent operators from ignoring/silencing them. Caution warnings may be designed to get the attention of an operator very quickly, for example by being prominent, loud, frequent, bright and the like. For example, alarms may display on a screen on the user interface in a very prominent manner, such as by blinking, taking up the entire user interface screen, etc. Alarms may initiate a loud sound, and may be designed to be annoying and/or attention getting in order to force the operator to take steps to remedy the situation. Once the operator takes steps to remedy the situation, the warnings may scale back from "alarm" to "caution" to "notification" classification and/or may stop completely.

[0114] The progressive/graduated warning system described in relation to FIG. **15** may utilize an "adaptive threshold" feature, whereby one or more thresholds (for example the preliminary, intermediate and critical thresholds) may be modified depending on the speed of one or more vehicles. The adaptive threshold feature may allow for scaling of thresholds of the alarm/notification levels based upon the speed of the immediate vehicle and the relative speed of the immediate vehicle and a vehicle that may collide with the immediate vehicle.

[0115] As explained above, the maintenance vehicles often work in work gangs comprising a plurality of vehicles, for example, a group of between four and forty vehicles, and the collision avoidance system is capable of tracking each vehicle that is part of the work gang. In some embodiments of the present technology, however, a single collision avoidance system may be responsible for tracking vehicles that are part of more than one work gang. For example, the collision avoidance system may track group A and group B. A collision avoidance system may be designed to distinguish between multiple work gangs so that the collision avoidance system can determine which vehicles are on the same track. In the event that maintenance vehicles are on two closely-located parallel tracks, it may be difficult for the collision avoidance system to determine which vehicles are on the same track and thus present real collision risks. The CAS may be adapted and/or programmed to handle work group designations/associations in order to limit unwanted detections of other maintenance vehicles on adjacent tracks.

[0116] In some embodiments, the VMMs and/or the CTU may include a switch, button, touch screen or the like that may be adapted to allow an operator to select from multiple group associations. All maintenance vehicles on a single track, for example, may set their switch, button, touch screen or the like to select the same group association/setting, and vehicles on a second parallel or other close but separate track may select a different group association/setting. The collision avoidance system may be adapted to ignore (or distinguish) the vehicles on the other tracks (vehicles with an alternate group association/setting), when tracking vehicles within a target group. For example, the work group selections/associations may allow the VMMs/CTU to only notify or alarm an operator when a separation distance violation is detected with other vehicles on the same track/rail. In some embodiments, the CAS may calculate the locations of vehicles using GPS data (or data from other positioning components) and may determine vector locations of such vehicles from which a reasonable calculation of track location can be determined. Other vehicles on an alternate vector could be dismissed by the collision avoidance system when tracking vehicles within a target group.

[0117] In some embodiments of the present disclosure, the CAS may include a stopping distance calibration feature and/or may perform a stopping distance calibration method. The stopping distance calibration feature/method may determine how quickly a rail line vehicle can stop under current conditions. For example, during a maintenance project, the work gang generally performs a stopping distance test (for example, at the beginning of each work day) where a vehicle is run at a speed (for example, 25 miles per hour) and then the vehicle's brakes may be engaged and a distance may be measured from the point where the brakes were engaged to the point where the vehicle comes to a stop. This distance may be referred to as the "stopping distance." If the weather changes and the tracks become wet (or dry), a similar stopping distance test may be performed again, and a new distance measured.

[0118] After the stopping distance is measured, the CAS may calculate various safety metrics based on the stopping distance. For example, a safe following distance between vehicles may be adjusted according to the stopping distance. In some embodiments, the collision avoidance system may maintain minimum/default metrics and then adjust the metrics if necessary based on the stopping distance. For example, a minimum/default following distance may be maintained in all situations, and the following distance may be adjusted upwards (extended) if the stopping distance is relatively high. The stopping distance may be used in conjunction with an adaptive threshold feature of a progressive/graduated warning system as described above. For example, one or more safe separation distance thresholds (for example preliminary, intermediate and critical thresholds) may be modified depending on the stopping distance. The adaptive threshold feature may allow for scaling of thresholds of the alarm/notification levels based upon the stopping distance. In one example, one or more alarm thresholds may be made more strict if the stopping distance is too high, resulting in earlier alarms, for example to allow sufficient time to stop under the current conditions.

[0119] The CAS may include an automatic/real-time stopping distance calibration feature that, when triggered, may automatically calculate the stopping distance using information from the vehicle mounted module's GPS unit and/or inertial measurement unit (for example an accelerometer or a gyroscope). The new following distance will then be automatically calculated and utilized automatically as the collision avoidance system monitors for proper vehicle separation distance.

[0120] The CAS may create and/or maintain one or more logs of events that occur during the operation of the collision avoidance system. The individual VMMs may log information regarding the vehicle on which the vehicle mounted module is mounted. The CTU may also log information regarding the several vehicles in the work gang that the CTU tracks. Saved logs may be downloadable by an authorized

person, for example via a cable or a wireless connection to a laptop computer or via an interface card. The amount of log data and time periods of data may be adjustable. Each log entry may be stamped with various types of information, for example the time and duration of the event occurrence, an ID, speed and location of the vehicle and the nature of the event. The collision avoidance system may also log information from a vehicle mounted module's inertial measurement unit (for example an accelerometer or a gyroscope) and/or other shock and impact sensors mounted on a vehicle to record significant impact data related to an incident. All warnings and alarms may be logged as well. Detailed log information may allow railroad personnel to reconstruct the details of an incident. The CAS may allow for logging of vehicle positioning over time using GPS satellite data. This feature allows long term tracking of vehicle location and activities. The CAS may allow for logging of data related to one or more stopping distance calibration tests, for example routine/daily stopping distance calibration tests and/or automatic/real-time stopping distance calibration tests.

[0121] In some embodiments of the present disclosure, the collision avoidance system may include the ability to monitor worker presence around machines so that a worker or foreman may be alerted if a worker is standing in an unsafe location. For example, if a worker is standing on the tracks near a vehicle as another vehicle approaches and violates a predetermined separation criteria, the worker and the foreman may be alerted, and perhaps emergency brakes may be activated. The collision avoidance system may monitor the workers by communicating with a communication device that is located on the worker, for example attached to the worker's badge. In one example, the communication device may be an RFID device. In another example, the communication device may be a UWB device, for example a subset of a UWB ranging system that includes components, some that are located on vehicles and some components that are located on workers.

[0122] A communication device located on a worker may communicate with one or more components located in one or more vehicle mounted modules, and/or it may communicate with a central tracking unit in a discrete housing. For example, if the communication device communicates with a vehicle mounted module, the vehicle mounted module may determine the orientation and distance of the worker in relation to the vehicle.

[0123] In some embodiments of the present disclosure, the collision avoidance system may utilize the concepts described herein to monitor the "vehicle stretch" of a train that includes several cars. As a train starts, stops and changes speed, the "play" in the couplings between the cars may allow the total length of the train to change. For example, if the train starts to slow down, the cars may compact closer to each other as the couplings lock more closely, and the overall length of the train may decrease. The opposite may occur if the train begins to accelerate, for example. Vehicle stretch is an important concept because it may be a measure of efficiency in the vehicle. Stretching and compacting of the vehicles wastes energy, and if the stretch of a vehicle can be monitored, the vehicle may be designed to reduce stretch. The collision avoidance system technologies described herein, for example the UWB technology and other close proximity sensing technologies, may be used to monitor distance between train cars, and then calculations can be made in the collision avoidance system to determine vehicle stretch.

[0124] In some embodiments of the present disclosure, the collision avoidance system may monitor, nationwide, locations and speeds of vehicles, equipment and/or workers equipped with collision avoidance system technology. For example, this may allow a central railroad office to monitor several work projects that are underway at several different locations throughout the country.

[0125] In some embodiments of the present disclosure, the collision avoidance system may have the ability to interface with rail line crossing technology to control gates while the vehicles work under the surveillance of the collision avoidance system. For example, if the collision avoidance system and the crossing technology were engineered by the same company, group or firm, the interface may be seamless.

[0126] Regarding the benefits of the collision avoidance system, in addition to the benefits already described in this disclosure, the following describes further benefits of one or more embodiments of the present technology. It is to be understood that the described benefits are not limitations or requirements, and some embodiments may omit one or more of the described benefits. In some embodiments, a benefit of the collision avoidance system may be that it is implemented as a supplement to existing safety procedures and devices already established for railroad maintenance vehicles and personnel. Alternatively, the collision avoidance system may be implemented as a primary (and perhaps the sole) collision avoidance and safety system.

[0127] Other benefits of the collision avoidance system can be realized when the collision avoidance system is compared to a single-sensor collision avoidance technology. Single sensor technologies do not work well when the work environment includes environmental and physical limitations. In addition to the complexities of tracking vehicles that travel through tunnels, mountains, building and the like, tracking vehicles can also become more complex when the vehicles travel or operate around curves or when the vehicles operate at night or during rain, snow and fog. Curves and other weather conditions create complex sensing environments that render single sensor technologies and/or strictly line-of-sight technologies inadequate. The multi-sensor approach of the collision avoidance system described above, allows for precise tracking of vehicles in these situations.

[0128] Another benefit of the collision avoidance system is that railroad companies can use the collision avoidance system to maintain an efficiently running railroad. For example, when an accident occurs in a remote area with single track, it may take days to re-open track after an accident. If the railroad companies can avoid more collisions and keep the tracks open, users of the railroad can make more efficient use of the railroad. A related benefit is that the collision avoidance system can significantly reduce the cost of running a railroad. Not only will the collision avoidance system help the railroad reduce the number of accidents, but the collision avoidance system logging functionality will give the railroads the ability to store data regarding accidents. This information may be used to alleviate rail payouts in the event of worker liability.

[0129] Although the present disclosure describes a collision avoidance system that may be applied to a work gang of railroad vehicles, the technology and the concepts described herein may be utilized in other vehicles, applications and/or industries, for example, in industries where spacing, location and status is important. Some industries that may utilize the

concepts described herein are (1) the construction industry, (2) the mining industry, (3) the airport industry, specifically on airport tarmacs.

[0130] In some alterative implementations of the present disclosure, the function or functions illustrated in the blocks or symbols of a block diagram or flowchart may occur out of the order noted in the figures, and/or may include more or less steps than are shown in the figures. For example in some cases two blocks or symbols shown in succession may be executed substantially concurrently or the blocks may sometimes be executed in the reverse order depending upon the functionality involved.

[0131] One or more embodiments of the present disclosure may be realized in hardware, software, or a combination of hardware and software. The present disclosure may be realized in a centralized fashion in at least one machine, computer and/or data processing system; or in a distributed fashion where different elements are spread across several interconnected machines, computers and/or data processing systems. Any kind of machine, computer and/or data processing system or other apparatus adapted for carrying out the methods described herein is suited. A typical combination of hardware and software may be a general-purpose computer system with a computer program that, when being loaded and executed, controls the computer system such that it carries out the methods and techniques described herein.

[0132] Some embodiments of the present disclosure may provide a non-transitory machine and/or computer-readable storage and/or media, having stored thereon, a machine code and/or a computer program having at least one code section executable by a machine, computer and/or data processing system, thereby causing the machine, computer and/or data processing system to perform the steps as described herein. One example of a data processing system is a general purpose computer.

[0133] Some embodiments of the present disclosure may also be embedded in a computer program product, which comprises all the features enabling the implementation of the methods described herein, and which when loaded in a computer system is able to carry out these methods. Computer program in the present context means any expression, in any language, code or notation, of a set of instructions intended to cause a system having an information processing capability to perform a particular function either directly or after either or both of the following: a) conversion to another language, code or notation; b) reproduction in a different material form.

[0134] In the present specification, use of the singular includes the plural except where specifically indicated. In the present specification, any of the functions recited herein may be performed by one or more means for performing such functions. The present systems and methods may include various means, modules, code segments, computer programs and/or software for performing one or more of the steps or actions described in this specification. It is expressly contemplated and disclosed that the present specification provides a written description for claims comprising such means, modules, steps, code segments, computer programs and/or software.

[0135] The description of the different advantageous embodiments has been presented for purposes of illustration and description and is not intended to be exhaustive or limited to the embodiments in the form disclosed. Many modifications and variations will be apparent to those of ordinary skill in the art. Further different advantageous embodiments may provide different advantages as compared to other advantageous embodiments. The embodiment or embodiments selected are chosen and described in order to best explain the principles of the embodiments the practical application and to enable others of ordinary skill in the art to understand the disclosure for various embodiments with various modifications as are suited to the particular use contemplated.

1. A rail line vehicle having a vehicle mounted module, the vehicle mounted module comprising

a transponder sensor module including an ultra wideband unit and a wireless communications antenna,

wherein the ultra wideband unit is operable to detect a distance between the rail line vehicle and at least one other vehicle,

wherein the wireless communications antenna is operable to send and receive data over the air;

a control electronics module including a processor that is in communication with at least the ultra wideband unit; and

a user interface module including a user interface,

wherein the user interface is operable to provide a vehicle operator with

information and is operable to accept input from the vehicle operator.

2. The rail line vehicle of claim **1** wherein the vehicle mounted module is in communication with one or more central tracking units by way of the wireless communications antenna,

wherein the one or more central tracking units are operable to track the location of the rail line vehicle and at least one other vehicle.

3. The rail line vehicle of claim **1** wherein the vehicle mounted module further comprises a central tracking unit module that is operable to track the location of at least one other vehicle.

4. The rail line vehicle of claim **1** wherein the transponder sensor module further includes a global positioning system,

wherein the global positioning system is operable to receive information from one or more satellites and is operable to determine the absolute position of the rail line vehicle.

5. The rail line vehicle of claim **4** wherein the vehicle mounted module is operable to utilize information generated by the global positioning system and the ultra wideband unit to

determine whether one or more vehicle separation criteria are violated, and

generate a warning if one or more vehicle separation criteria are violated.

6. The rail line vehicle of claim **1** wherein the user interface module further includes a service interface operable to allow the vehicle operator to configure, calibrate, service, maintain, diagnose, update and/or install information on vehicle mounted module.

7. The rail line vehicle of claim **1** wherein the control electronics module further includes one or more interfaces that are operable to communicate with ground speed detection modules.

8. The rail line vehicle of claim **7** wherein the ground speed detection modules include one or more of a microwave radar, a laser device, an infrared sensor and an ultra wideband sensor.

9. The rail line vehicle of claim **1** wherein the control electronics module further includes one or more inertial measurement units.

10. The rail line vehicle of claim 1 wherein the vehicle mounted modules comprises one or more additional transponder sensor modules,

wherein the vehicle mounted module is operable to accept calibration information regarding the length of the rail line vehicle and the mounting locations of the transponder sensor module and the one or more additional transponder sensor modules.

11. The rail line vehicle of claim 1 wherein the vehicle mounted modules comprises an additional ultra wideband unit, wherein an offset exists between the ultra wideband unit and the additional ultra wideband unit once the two units are mounted on the rail line vehicle.

12. The rail line vehicle of claim 1 wherein the ultra wideband unit is adapted to transmit and receive signals with varying center frequencies.

13. The rail line vehicle of claim 1 wherein the transponder sensor module further includes one or more of a laser device, a radar sensor and an infrared sensor.

14. The rail line vehicle of claim 1 wherein the user interface is a touchscreen including a screen, the touchscreen being operable to

display one or more screens, menus, options and/or functions, and

accept user input from the vehicle operator by allowing the vehicle operator to touch the screen of the touchscreen.

15. The rail line vehicle of claim 1 wherein the vehicle mounted module is operable to utilize a progressive warning feature that generates a warning if one or more vehicle separation thresholds are violated,

wherein the rate, frequency, prominence and/or severity of the warning increases as the violation of the vehicle separation threshold becomes more critical.

16. The rail line vehicle of claim 15 wherein the progressive warning feature utilizes an adaptive threshold feature that modifies the one or more vehicle separation thresholds based on the speed of the rail line vehicle and the speed of one or more nearby vehicles.

17. The rail line vehicle of claim 1 wherein the vehicle mounted module is operable to utilize a stopping distance calibration feature that measures a stopping distance,

wherein the stopping distance indicates how quickly the rail line vehicle can stop under current conditions.

18. The rail line vehicle of claim 17 wherein the measured stopping distance is used to modify one or more safe separation distance thresholds.

19. The rail line vehicle of claim 1 wherein the control electronics module further includes an inertial measurement unit.

20. A collision avoidance system comprising:

one or more vehicle mounted modules, each mounted on a vehicle,

each vehicle mounted module comprising:

a transponder sensor module including an ultra wideband unit and a wireless communications antenna,

wherein the ultra wideband unit is operable to detect a distance between the vehicle on which the vehicle mounted module is mounted and at least one other vehicle,

wherein the wireless communications antenna is operable to send and receive data over the air;

a control electronics module including a processor that is in communication with at least the ultra wideband unit; and

a user interface module including a user interface,

wherein the user interface is operable to provide a vehicle operator with information and is operable to accept input from the vehicle operator; and

a central tracking unit that is in communication with the one or more vehicle mounted modules, the central tracking unit being operable to track the location of the one or more vehicle mounted modules.

21. The collision avoidance system of claim 20 wherein the central tracking unit is distributed among the one or more vehicle mounted modules, wherein

each of the one or more vehicle mounted modules includes a central tracking unit component,

each central tracking unit component is in communication with the vehicle's control electronics module.

22. The collision avoidance system of claim 20 wherein the central tracking unit is disposed in a discrete housing.

23. The collision avoidance system of claim 20 wherein the transponder sensor module further includes a global positioning system,

wherein the global positioning system is operable to receive information from one or more satellites and is operable to determine the absolute position of the vehicle mounted module.

24. The collision avoidance system of claim 20 wherein each vehicle mounted module is operable to utilize information generated by the global positioning system, the ultra wideband unit and the central tracking unit to

determine whether one or more vehicle separation criteria are violated, and generate a warning if one or more vehicle separation criteria are violated.

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(54) **RAIL LINE SENSING AND SAFETY SYSTEM**

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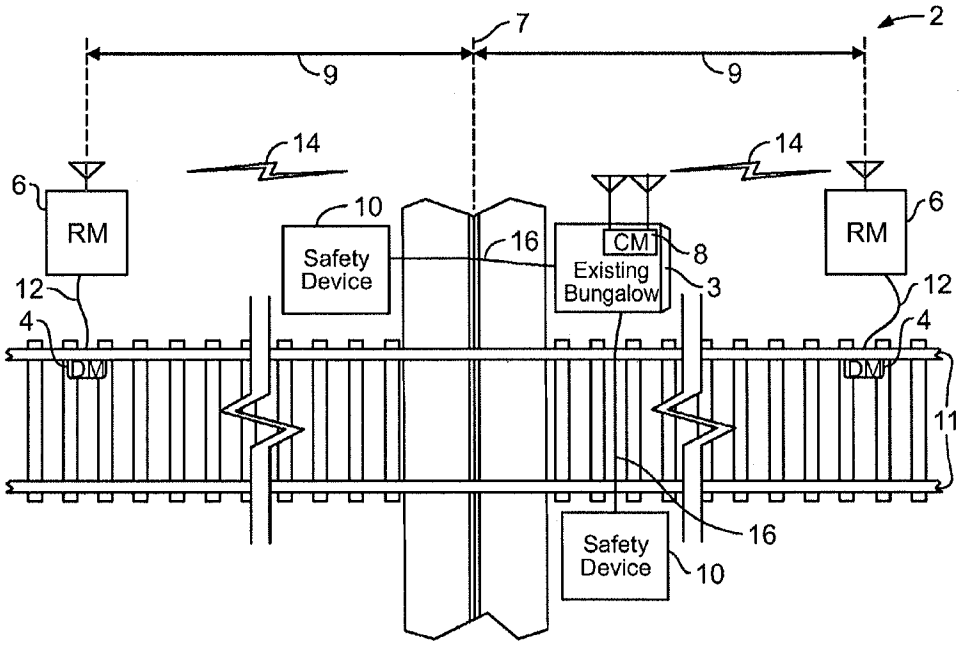
(51) **Int. Cl.**

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B61L 29/02	(2006.01)
B61L 5/12	(2006.01)

(52) **U.S. Cl.** ..... **246/126**; 246/473 R

(57) **ABSTRACT**

A rail line sensing and safety system adapted to reliably sense the presence, and optionally the direction and speed, of vehicles traveling on a rail line, and when a vehicle is sensed, to indicate whether a safety device, such as crossing gates, lights, bells, etc., should be activated. The system comprises at least one detection module typically mounted on a rail, at least one remote module typically located near a detection module, and at least one control module typically located near a safety device. In operation, a detection module senses a vehicle traveling on a rail line and sends signals to a remote module. The remote module then processes signals received from the detection module and transmits signals to the control module. The control module then directs, either directly or indirectly as a backup or supplement to an existing sensing and safety system, whether a safety device should be activated.



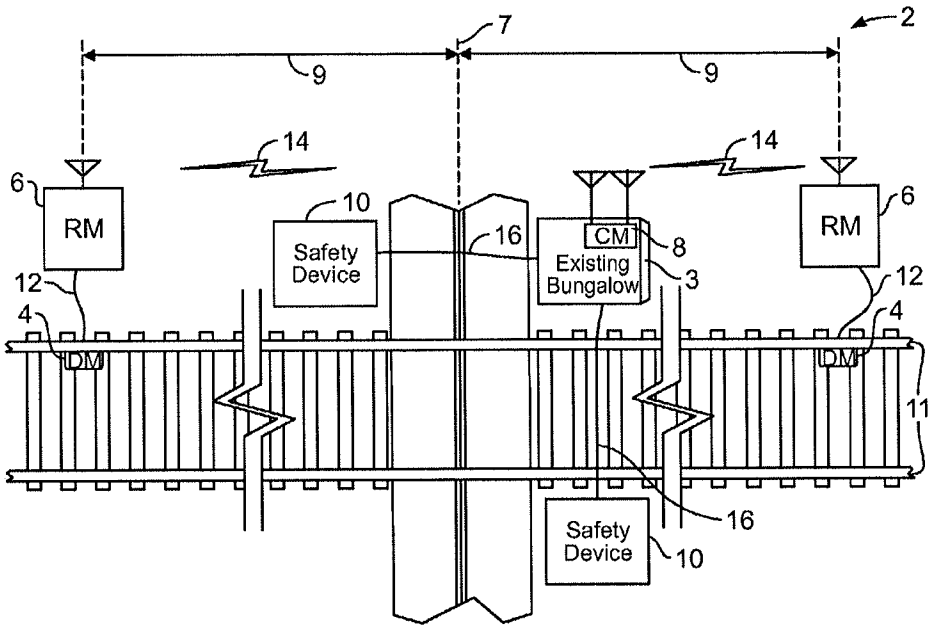

7
2
9
9
14
14
6
RM
10
Safety Device
16
CM
Existing Bungalow
8
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RM
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DM
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16
Safety Device
10

FIG. 1

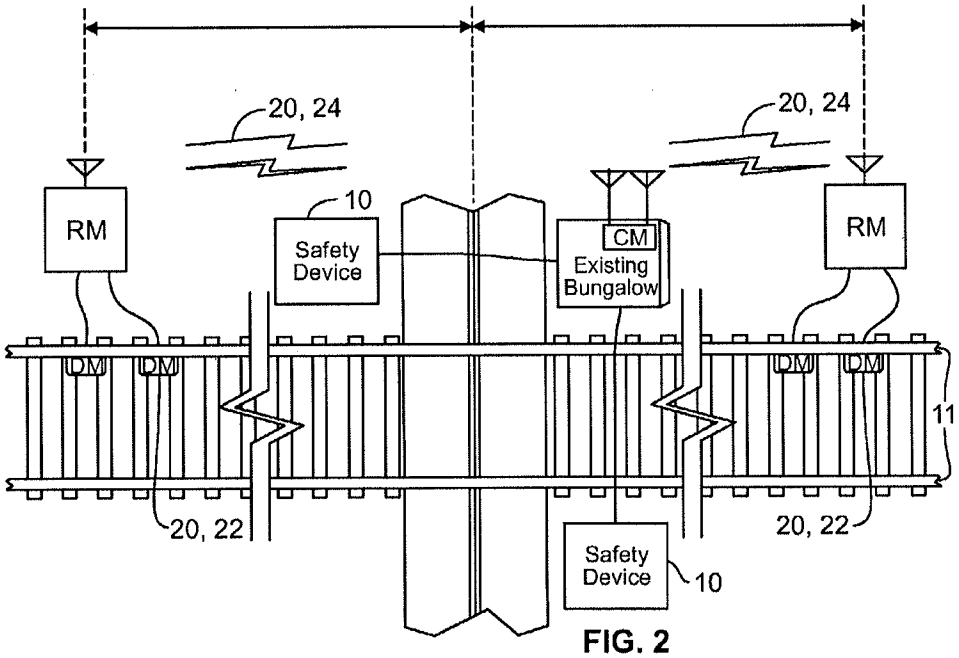

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Safety Device
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Safety Device
10

FIG. 2

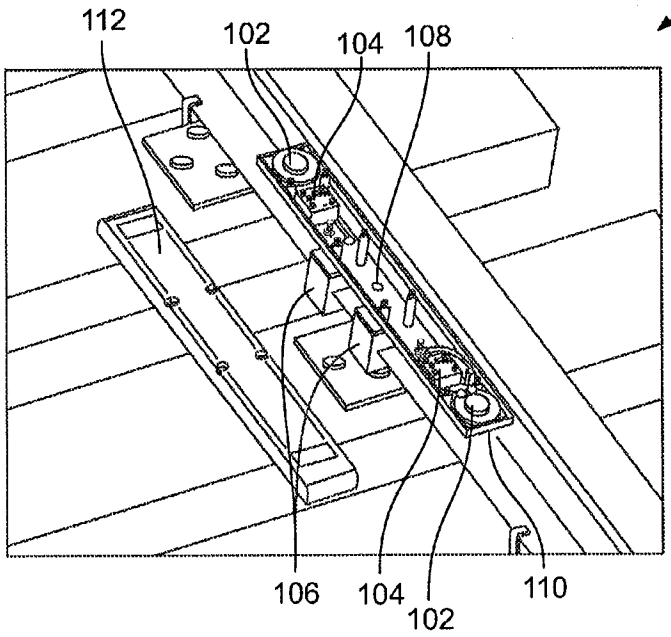


FIG. 3

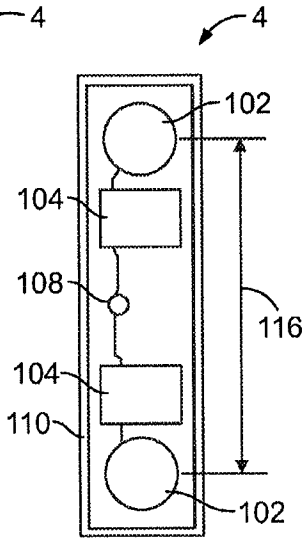


FIG. 4

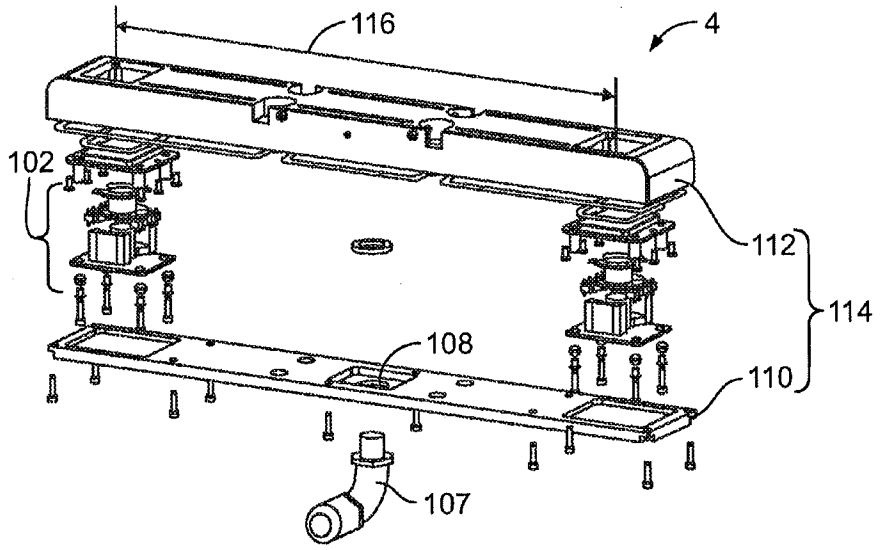


FIG. 5

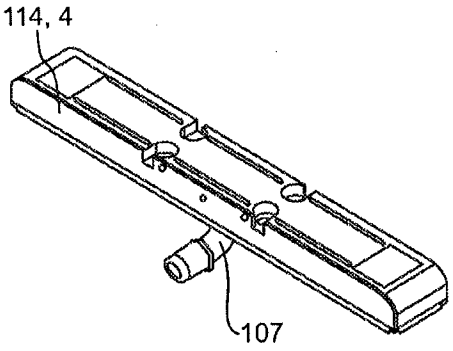


FIG. 6

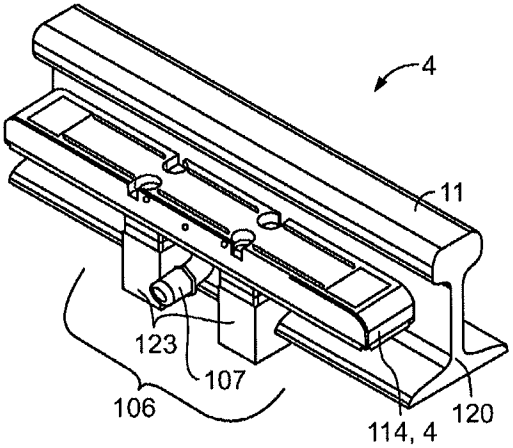


FIG. 7

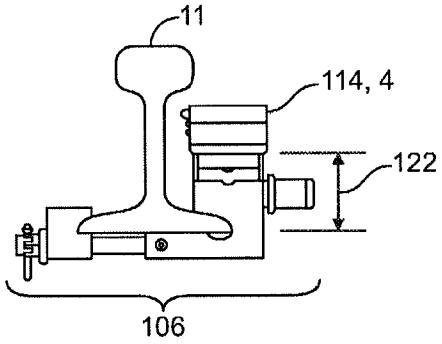


FIG. 8

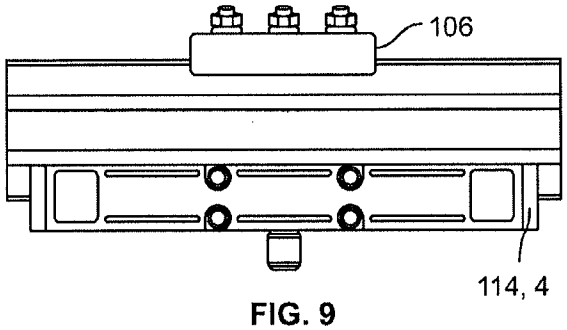


FIG. 9

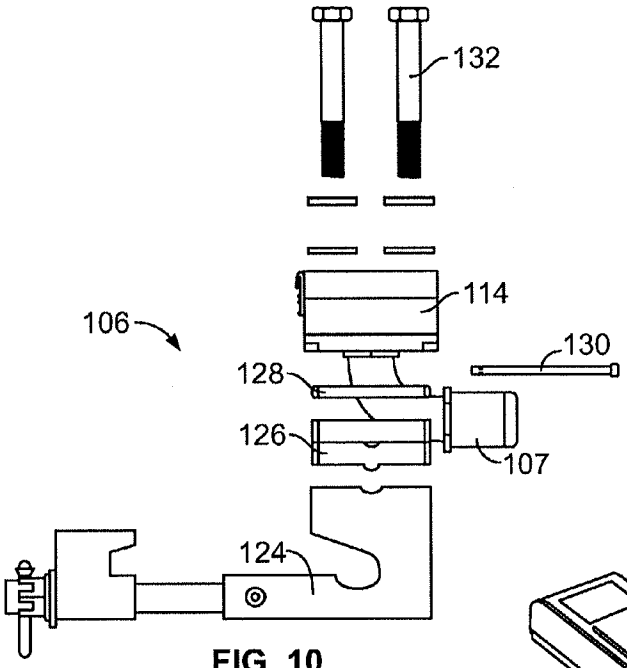


FIG. 10

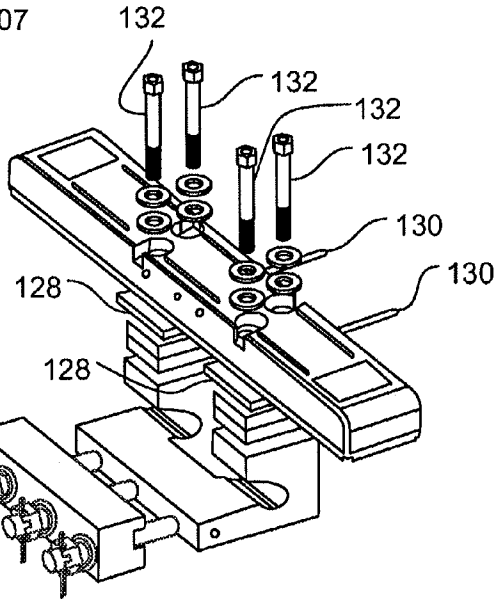


FIG. 11

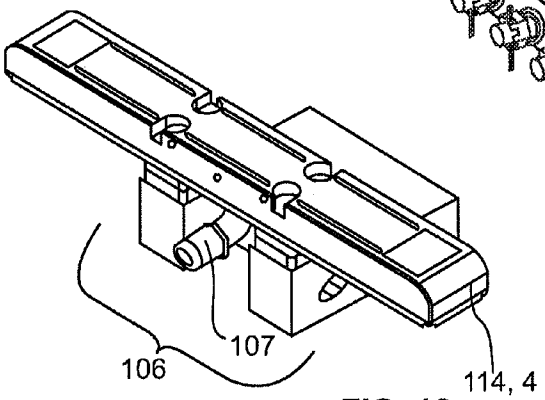


FIG. 12

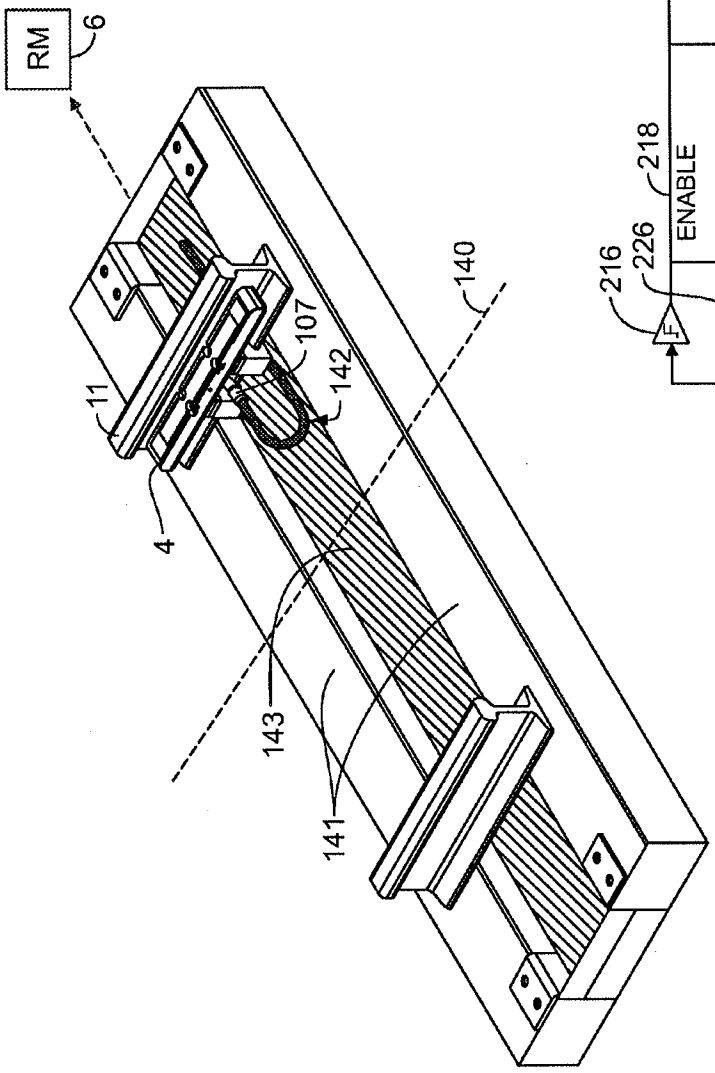

RM
6
11
4
107
142
140
143
141

FIG. 13

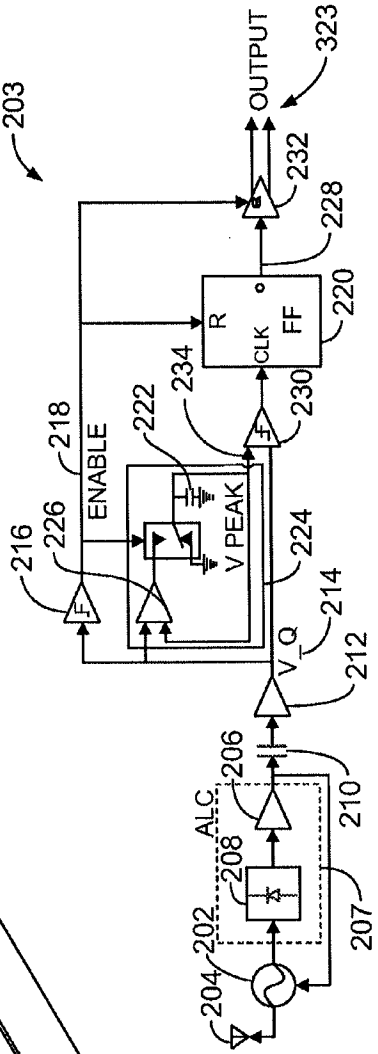

203
OUTPUT
323
232
228
220
R
CLK
FF
234
222
218
ENABLE
230
216
226
V PEAK
224
214
V_Q
212
206
ALC
208
210
202
207
204

FIG. 14

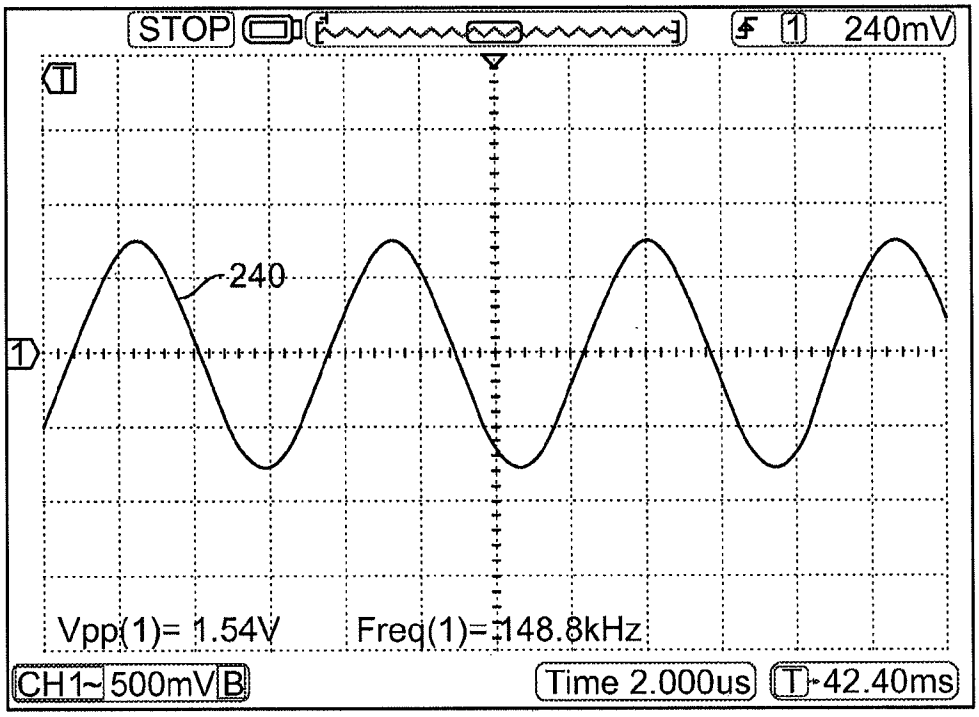

STOP
1 240mV
240
Vpp(1)= 1.54V
Freq(1)= 148.8kHz
CH1~ 500mV B
Time 2.000us
T 42.40ms

FIG. 15

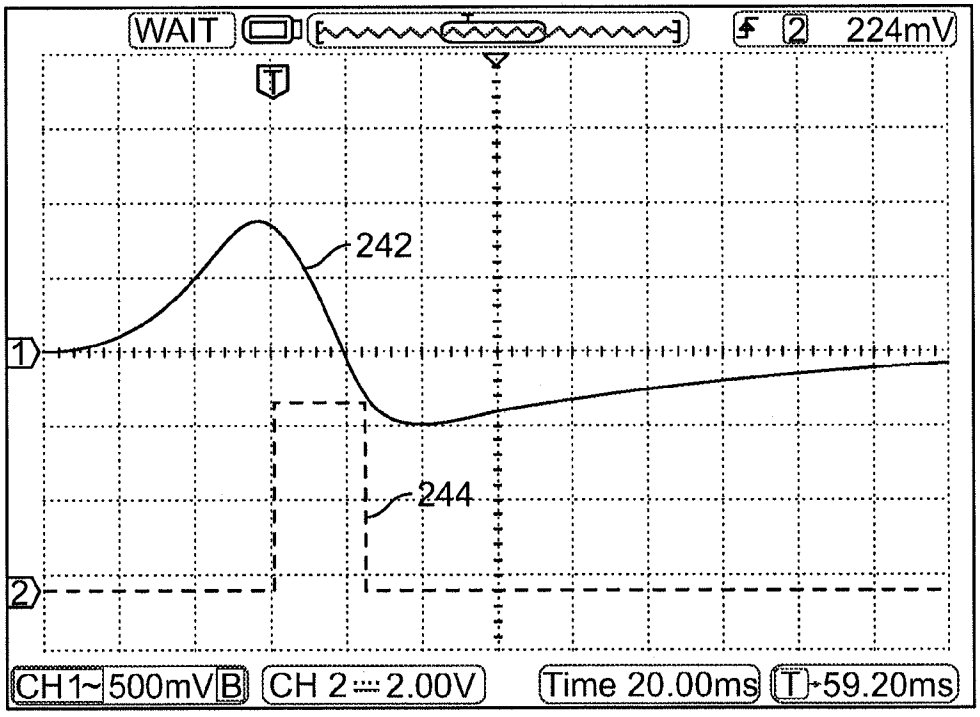

WAIT
2 224mV
242
244
CH1~ 500mV B
CH 2 2.00V
Time 20.00ms
T 59.20ms

FIG. 16

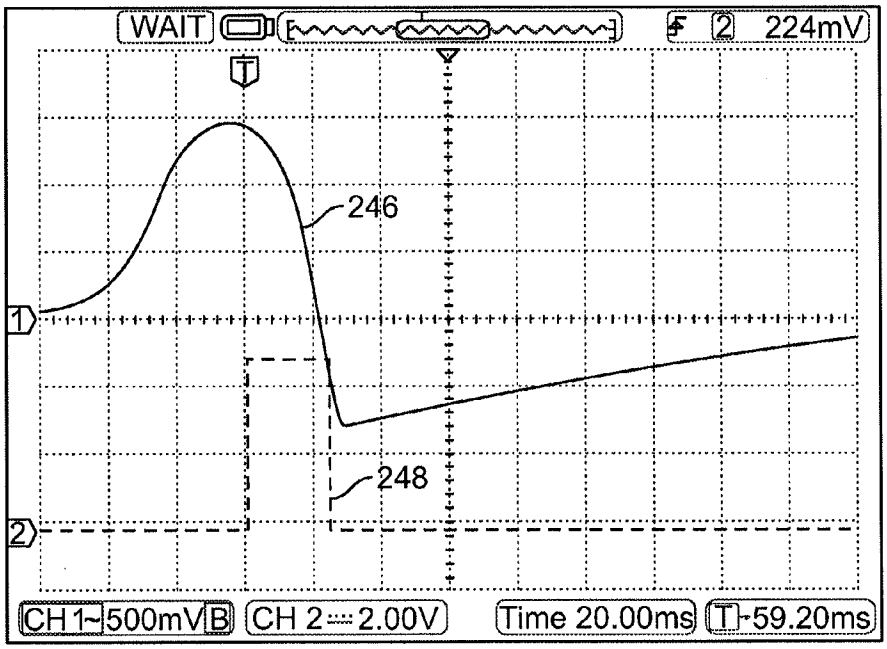

WAIT
2 224mV
246
248
CH 1~500mV B
CH 2 2.00V
Time 20.00ms
T -59.20ms

FIG. 17

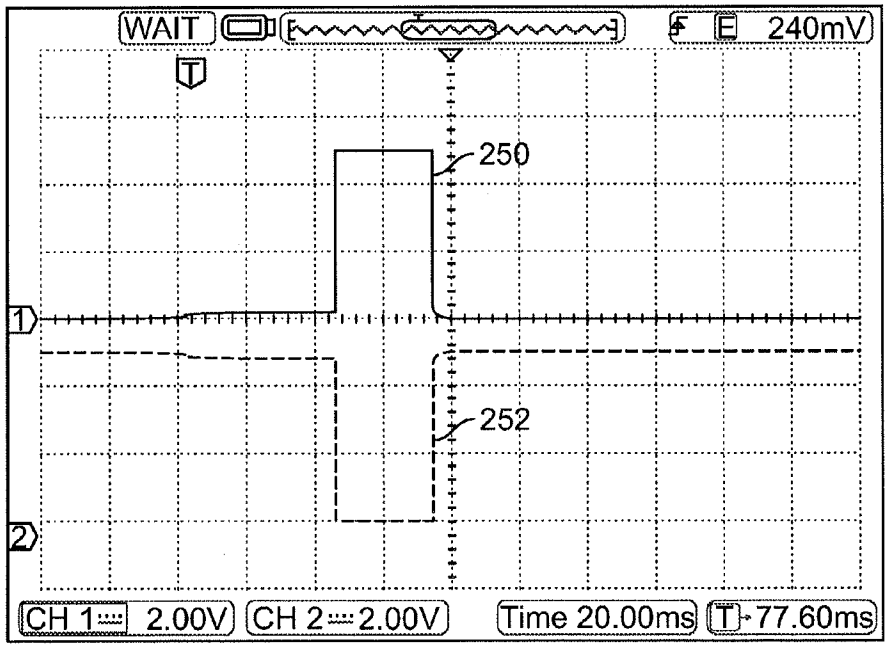

WAIT
E 240mV
250
252
CH 1 2.00V
CH 2 2.00V
Time 20.00ms
T -77.60ms

FIG. 18

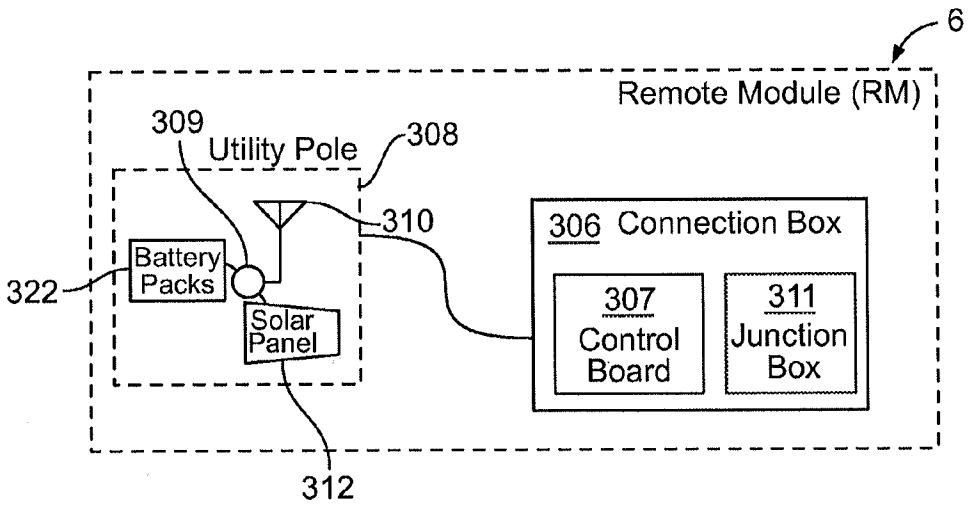


FIG. 19A

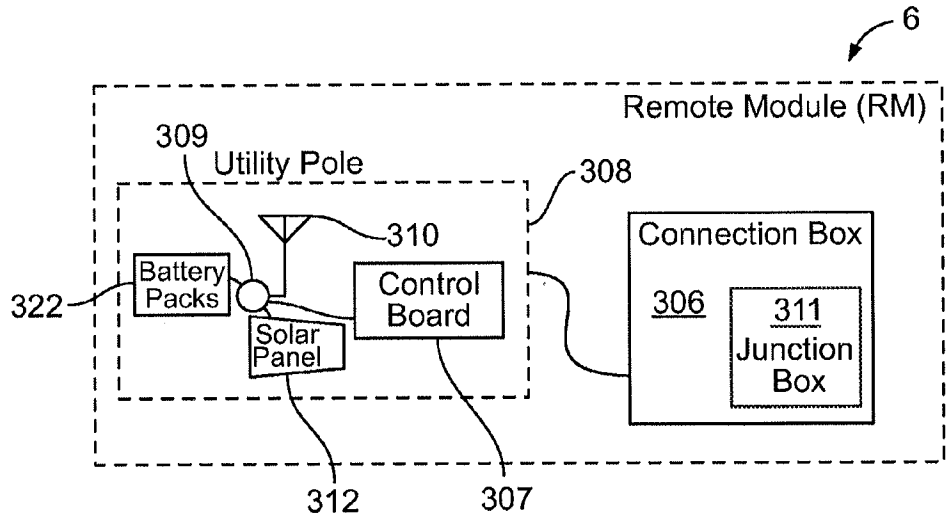


FIG. 19B

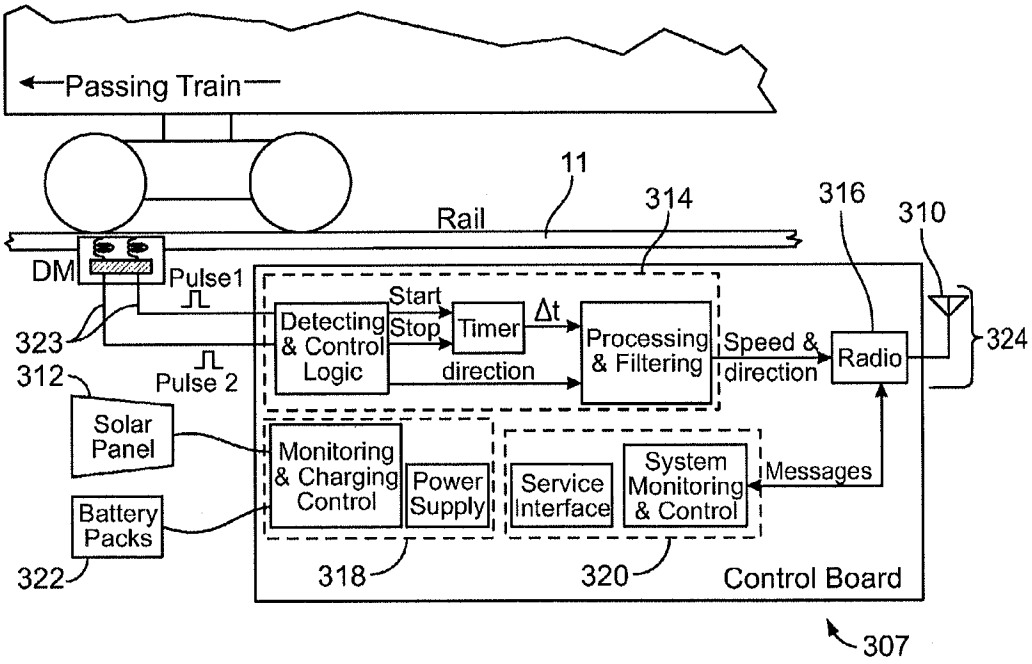

Passing Train
11
Rail
314
316
310
DM
Pulse1
Start
Stop
Timer
Δt
Detecting & Control Logic
Processing & Filtering
Speed & direction
Radio
324
323
direction
312
Pulse 2
Solar Panel
Monitoring & Charging Control
Power Supply
Service Interface
System Monitoring & Control
Messages
Battery Packs
322
318
320
Control Board
307

FIG. 20

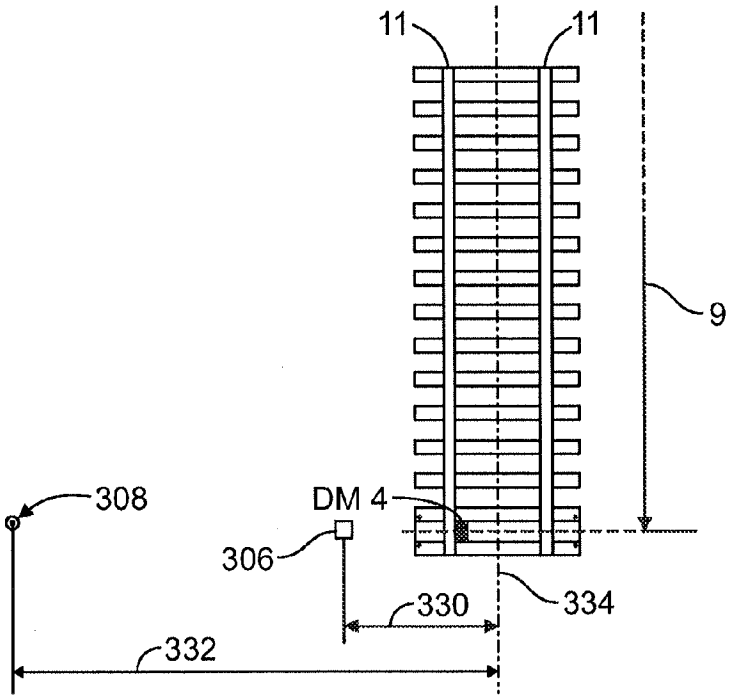

11
11
9
308
DM 4
306
330
334
332

FIG. 21

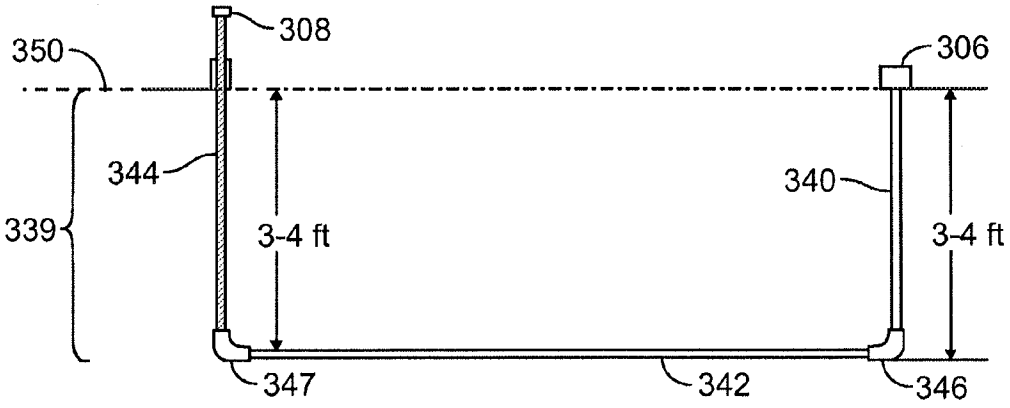

350
308
306
344
340
339
3-4 ft
3-4 ft
347
342
346

FIG. 22

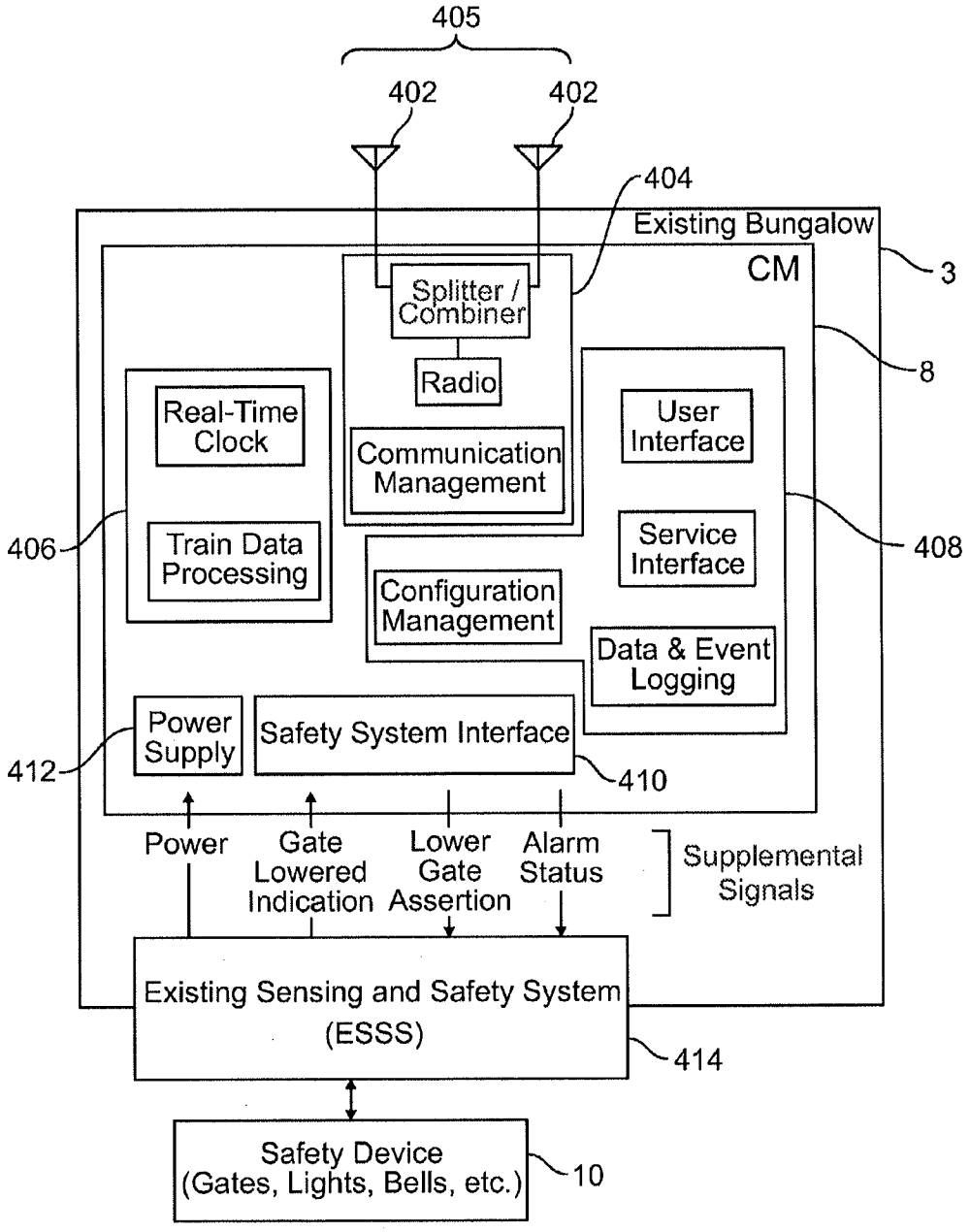

405
402
402
404
Existing Bungalow
CM
3
Splitter / Combiner
Radio
8
Real-Time Clock
Communication Management
User Interface
406
Train Data Processing
Service Interface
408
Configuration Management
Data & Event Logging
Power Supply
Safety System Interface
412
410
Power
Gate Lowered Indication
Lower Gate Assertion
Alarm Status
Supplemental Signals
Existing Sensing and Safety System (ESSS)
414
Safety Device (Gates, Lights, Bells, etc.)
10

FIG. 23

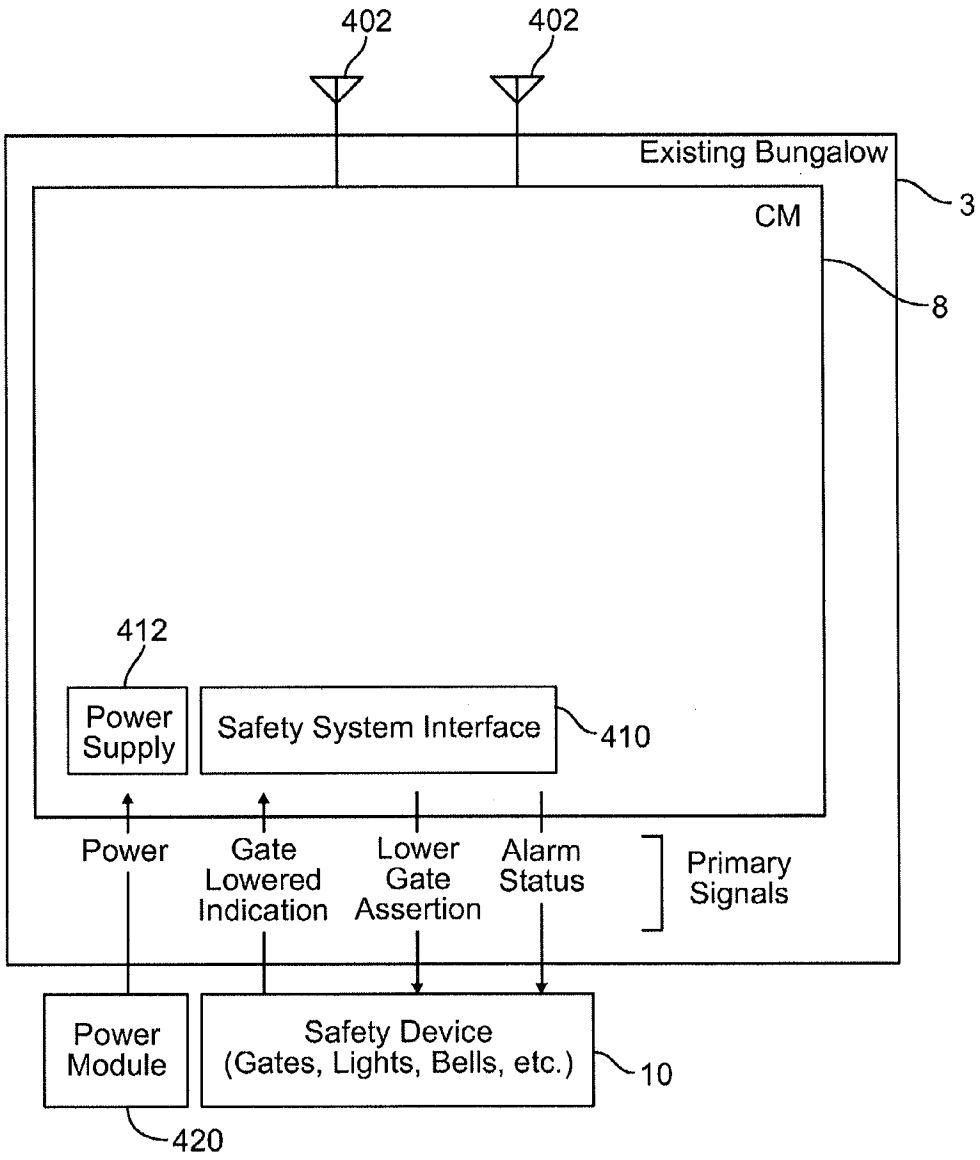

402
402
Existing Bungalow
3
CM
8
412
Power Supply
Safety System Interface
410
Power
Gate Lowered Indication
Lower Gate Assertion
Alarm Status
Primary Signals
Power Module
Safety Device (Gates, Lights, Bells, etc.)
10
420

FIG. 24

RAIL LINE SENSING AND SAFETY SYSTEM

CROSS-REFERENCE TO RELATED APPLICATION(S)

[0001] This application claims priority from the following four U.S. Provisional Patent Applications: (1) No. 61/458,805 filed on Dec. 3, 2010, (2) No. 61/457,532 filed on Apr. 18, 2011, (3) No. 61/519,202 filed on May 19, 2011, and (4) No. 61/627,270 filed on Oct. 11, 2011. The disclosures of these four applications are incorporated by reference herein in their entireties.

BACKGROUND

[0002] Rail lines, such as railroads for trains, create safety concerns where they intersect with roads, other rail lines or other paths of travel. These intersections (crossings) are notorious for collisions between vehicles. Various types of safety devices (for example, lights and crossing gates) are used to warn approaching vehicles of a potential collision. However, current systems for sensing an approaching train and activating a safety device are not sufficiently reliable under certain operating conditions.

BRIEF DESCRIPTION OF THE DRAWINGS

[0003] Several features and advantages are described in the following disclosure, in which several embodiments are explained, using the following drawings as examples.

[0004] FIG. **1** shows a bird's eye schematic view of a rail line sensing and safety system.

[0005] FIG. **2** shows a bird's eye schematic view of a rail line sensing and safety system.

[0006] FIG. **3** shows an angled top view of a sensing device, also referred to as a detection module, according to the disclosure.

[0007] FIG. **4** shows a bird's eye schematic view of a detection module.

[0008] FIG. **5** shows an exploded, angled side view of a detection module.

[0009] FIG. **6** shows an angled top view of a detection module.

[0010] FIG. **7** shows an angled top view of a detection module, mounted to a rail.

[0011] FIG. **8** shows a cross-sectional side view of a detection module, mounted to a rail.

[0012] FIG. **9** shows a bird's eye view of a detection module, mounted to a rail.

[0013] FIG. **10** shows an exploded side view of a mounting system for a detection module.

[0014] FIG. **11** shows an exploded, angled top view of a mounting system for a detection module.

[0015] FIG. **12** shows an angled top view of a detection module and a mounting system.

[0016] FIG. **13** shows an angled top view of a detection module, mounted to a rail.

[0017] FIG. **14** shows a circuit diagram of circuitry that may be associated with sensors located inside a detection module.

[0018] FIG. **15** shows a sinewave that may be produced by an oscillator that may be part of the circuitry associated with sensors located inside a detection module.

[0019] FIG. **16** shows a timing relationship that may result between a voltage in the circuitry, associated with sensors located inside a detection module, and one of the circuitry's output pulses.

[0020] FIG. **17** shows a timing relationship that may result between a voltage in the circuitry, associated with sensors located inside a detection module, and one of the circuitry's output pulses.

[0021] FIG. **18** shows output pulses that may be generated by circuitry associated with sensors located inside a detection module.

[0022] FIG. **19**A shows a block diagram of a remote module, according to the disclosure.

[0023] FIG. **19**B shows a block diagram of a remote module, according to the disclosure.

[0024] FIG. **20** shows a block diagram of a remote module in relation to a detection module and a rail.

[0025] FIG. **21** shows the installation location of at least some subcomponents of a remote module.

[0026] FIG. **22** shows the installation location of at least some subcomponents of a remote module.

[0027] FIG. **23** shows a block diagram of a control module, according to the disclosure.

[0028] FIG. **24** shows a block diagram of a control module.

BRIEF DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0029] The following disclosure describes a rail line sensing and safety system adapted to reliably sense the presence, as well as the direction and speed, of vehicles, including high-speed vehicles, traveling on a rail line. The rail line sensing and safety system then indicates whether a safety device, such as crossing gates, lights, bells, visual, audio or physical warnings, and combinations thereof, should be activated.

[0030] In one embodiment, the rail line sensing and safety system comprises at least one sensing device (also referred to as a detection module) for a rail line. The sensing device in turn comprises: (1) a first sensor capable of detecting a vehicle traveling on the rail line and signaling a first detection event; (2) a second sensor capable of detecting the vehicle traveling on the rail line and signaling a second detection event, wherein the second sensor is located a fixed distance away from the first sensor; (3) electrical circuitry that accepts signals from the two sensors; and (4) electrical connections that electrically connect the two sensors and the electrical circuitry.

[0031] In one example of the sensing device, the first sensor and the second sensor may be inductive sensors, each sensor comprising wire wound on a ferrite core, and wherein the wire is Litz Wire, and wherein each sensor is capable of generating a magnetic field that extends a distance above the sensor, and wherein the electrical circuitry is capable of detecting an interruption in the magnetic field of either the first sensor, the second sensor, or both. The ferrite core may be, for example, a PQ-style ferrite core.

[0032] In another example of the sensing device, the first sensor and the second sensor may comprise a coil of wire operable to inductively couple to at least one part of the vehicle traveling on the rail line, and wherein the electrical circuitry is configured to generate, for the first sensor, a first coupling signal and a first output pulse signal, the magnitude of the first coupling signal being based on the amount of inductive coupling between the coil of wire of the first sensor

and the vehicle, the first output pulse signal being an output pulse triggered in response to the first coupling signal indicating that the amount of inductive coupling between the coil of wire of the first sensor and the vehicle is approximately at a maximum, and wherein the electrical circuitry is configured to generate, for the second sensor, a second coupling signal and a second output pulse signal, the magnitude of the second coupling signal being based on the amount of inductive coupling between the coil of wire of the second sensor and the vehicle, the second output pulse signal being an output pulse triggered in response to the second coupling signal indicating that the amount of inductive coupling between the coil of wire of the second sensor and the vehicle is approximately at a maximum.

[0033] In this example, as the vehicle gets closer to the sensor's coil of wire, the amount of inductive coupling between the coil of wire and the vehicle increases and the Q factor of the coil of wire decreases, and wherein the magnitude of the coupling signal increases when the amount of inductive coupling between the coil of wire and the vehicle increases.

[0034] In this example, the first output pulse signal generated by the circuitry for the first sensor corresponds to the signaling of the first detection event, and the second output pulse signal generated by the circuitry for the second sensor corresponds to the signaling of the second detection event.

[0035] In this example, the electrical circuitry may comprise, for each of the first sensor and the second sensor, a peak-and-hold detector that is operable to detect a peak in the magnitude of the coupling signal, and trigger the output pulse signal when the peak in the magnitude of the coupling signal is detected. The electrical circuitry may comprise, for each of the first sensor and the second sensor, a capacitor located between the wire carrying the coupling signal and the peak-and-hold detector, and wherein the capacitor removes a DC component of the coupling signal, allowing only an AC component of the coupling signal to pass through to the peak-and-hold detector, and wherein the capacitor ensures that static DC-signal drift in the coupling signal is not introduced to the peak-and-hold detector.

[0036] In this example, the electrical circuitry may comprise, for each of the first sensor and the second sensor, an amplifier operable to amplify the coupling signal, the amplifier comprising a feedback path having a Zener diode to produce a logarithmic transfer characteristic of the amplifier such that the amplifier is capable of accurately handling the coupling signal regardless of whether its magnitude is large or small. The electrical circuitry may also comprise, for each of the first sensor and the second sensor, a comparator operable to terminate the output pulse when the magnitude of the coupling signal falls from a peak magnitude to below a threshold value. The electrical circuitry may also be operable to detect an error or a fault in the electrical circuitry and to generate an error signal when the error or fault is detected.

[0037] In another example of the sensing device, the sensing device further comprises a sensor package that houses at least the two sensors, the electrical circuitry and the electrical connections, wherein the sensor package includes an upper casing and a lower casing such that when the two casings are affixed together, a cavity is defined between them, wherein the sensor package includes an attachment device for attaching the sensor package to the rail line.

[0038] In this example, the attachment device may be an energy absorbing mounting system comprised of: (1) a clamp assembly for attaching the sensor package to the rail line; (2) aluminum shims and vibration absorption pads disposed between the sensor package and the clamp assembly, wherein the vibration absorption pads are composed of rubber or an elastomeric material or other vibration absorbing material; (3) cap screws that run vertically through the sensor package, the aluminum shims, the vibration absorption pads, and into the clamp assembly, wherein the cap screws apply clamping force to attach the sensor package to the rest of the attachment device and to hold the parts of the attachment device together; and (4) lock pins that are inserted horizontally into the side of the sensor package to prevent the cap screws from rotating.

[0039] In another example of the sensing device, the electrical circuitry of the sensing device may include a signal processor. The signal processor may be programmed to calculate the direction, speed or both of the vehicle traveling on the rail line by detecting the order of the first detection event in relation to the second detection event, and measuring the time period between the detection events.

[0040] In another example of the sensing device, the sensing device may further comprise at least one additional sensor capable of detecting the vehicle traveling on the rail line and signaling at least one additional detection event, wherein the electrical circuitry also accepts signals from the at least one additional sensor, wherein the electrical connections also electrically connect the at least one additional sensor.

[0041] In one embodiment of the rail line sensing and safety system, the system comprises: (1) at least one sensing device for a rail line according to claim **1**, wherein each sensing device outputs one or more signals that indicate at least one of the presence, direction and speed of a vehicle traveling on the rail line; (2) at least one remote module that accepts signals outputted by at least one of the sensing devices, wherein the remote module processes signals and transmits one or more signals, wherein the remote module is located near the sensing device from which it accepts signals; and (3) a control module that accepts signals outputted by at least one of the remote modules, wherein the control module performs operations based on signals and outputs one or more signals, wherein the signals outputted by the control module indicate, among other things, whether one or more safety devices should be activated, the safety devices being lights, gates, bells, visual, audio or physical warnings, and combinations thereof, wherein the control module and the safety devices are located near an intersection of a rail line and a road, a second rail line, or other path of travel.

[0042] In one example, the rail line sensing and safety system further comprises one or more solar panels electrically connected to one or more devices or modules, including the sensing device, the remote module and the control module; and one or more battery packs electrically connected to one or more devices or modules, including the sensing device, the remote module and the control module.

[0043] In another example of the rail line sensing and safety system, the signals outputted by the control module are sent directly to the one or more safety devices, and wherein the rail line sensing and safety system provides primary control signals for the safety devices. In this example, the rail line sensing and safety system may further comprise at least one backup sensing device, wherein at least one sensing device located on either side of the safety devices is backed up, as a form of redundancy, by the at least one backup sensing device, wherein the backup sensing device is located a distance away from the sensing device that it backs up, wherein

the backup sensing device outputs signals that indicate at least one of the presence, direction and speed of a vehicle traveling on the rail line.

[0044] In another example of the rail line sensing and safety system, the system is adapted to be a supplemental or backup system to a separate existing system, wherein the signals outputted by the control module are sent to the existing system, and wherein the existing system controls one or more safety devices. The existing system may attempt to detect the vehicle traveling on the rail line by sending one or more electrical signals down one or more rails of the rail line, whereby the rail operates as a conductor for the one or more signals to travel through. In this example, the rail line sensing and safety system may further comprising at least one backup sensing device, wherein at least one sensing device located on either side of the safety devices is backed up, as a form of redundancy, by the at least one backup sensing device, wherein the backup sensing device is located a distance away from the sensing device that it backs up, wherein the backup sensing device outputs signals that indicate at least one of the presence, direction and speed of a vehicle traveling on the rail line.

[0045] In another example of the rail line sensing and safety system, the system may further comprise at least one sensor that monitors health of at least one device or module in the system, including the sensing device and the remote module, wherein the signals transmitted by the remote module and sent to the control module periodically include information regarding health of at least one device or module, wherein the control module is adapted to accept signals and information regarding health of devices or modules.

[0046] In another example of the rail line sensing and safety system, the control module may include computing equipment capable of data logging and self-diagnostics. Additionally, the system may further comprise a display that is part of the control module, wherein the display conveys system diagnostics and status indicators.

[0047] In another example of the rail line sensing and safety system, the remote module may transmit one or more signals using a frequency hopping radio. Alternatively, the remote module may transmit one or more signals using a cellular network. Alternatively, the remote module may transmit one or more signals using a licensed frequency.

[0048] In another example of the rail line sensing and safety system, the sensing device may be located a distance away from the one or more safety devices that the sensing and safety system controls, wherein the distance is between 3,800 feet and 4,500 feet.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0049] The rail industry could benefit from a system, according to this disclosure, that addresses concerns such as safety, reliability, efficiency, ease of control and cost. These concerns only increase with the introduction of high speed vehicles traveling on rail lines.

[0050] The following disclosure describes a rail line sensing and safety system (RLSSS) adapted to reliably sense the presence, as well as the direction and speed, of vehicles, including high-speed vehicles, traveling on a rail line. The rail line sensing and safety system then indicates whether a safety device, such as crossing gates, lights, bells, visual, audio or physical warnings, and combinations thereof, should be activated.

[0051] FIG. **1** shows a rail line sensing and safety system (RLSSS) **2** according to an embodiment of the disclosure. The rail line sensing and safety system **2** comprises at least one detection module (DM) **4**, at least one remote module (RM) **6**, and at least one control module (CM) **8**. Typically, the rail line sensing and safety system **2** will include two detection modules and two remote modules, one of each located on each side of a safety device **10**; however, it should be noted that the rail line sensing and safety system **2** may contain more detection modules and remote modules. Typically, the rail line sensing and safety system **2** will include a single control module **8**, adapted to accept signals sent from multiple remote modules **6**, however, it should be noted that the rail line sensing and safety system **2** may contain more than one control module **8**. Additionally, although the following description may refer to the safety device **10** as a crossing gate or other type safety device, it should be understood that the safety device **10** may comprise many types of safety and warning devices, such as crossing gates, lights, bells, visual, audio or physical warnings, and combinations thereof.

[0052] The detection modules **4** are each generally connected, in close proximity, with their closest remote module **6**, for example by a hard-wired connection **12**. In one example, the detection module **4** is hard-wired by a short cable **12** to the remote module **6**, instead of utilizing a wireless connection. One benefit of a hard-wired connection, instead of a wireless connection, is that the hard-wired connection can be used to feed power, in addition to electrical signals, to the detection modules **4**. In this setup, the detection modules **4** may be powered by one or more solar panels **312**, battery packs **322**, and a power control module that are part of the closest remote module **6** (see FIGS. **19**A, **19**B and **20**). Alternatively, in this setup, the detection modules **4** may be powered by a power source located in or near the control module **8**, provided that the wireless link **14** is replaced by a wired connection.

[0053] In operation, the detection module **4** detects a vehicle traveling on the rail **11** and sends one or more signals, for example, by a wired communication link **12**, to a nearby remote module **6**. The remote module **6** contains circuitry that processes signals received from the detection module **4**. The remote module **6** then transmits one or more signals to the control module **8**, for example by a radio link **14**. In some installations, the connection between the remote modules **6** and the control module **8** may be by a wired connection instead of a radio link. The control module **8** also operates in communication, for example by a wired communication link **16**, with a safety device **10**, either directly or indirectly as a backup or supplement to an existing sensing and safety system (ESSS).

[0054] The detection modules **4** are mounted a distance **9** down the track from the centerline **7** between the two safety devices **10**. This distance is typically between 3,800 feet and 4,500 feet, although other distances may allow the detection modules **4** to function properly. In general, the greater the distance **9**, the more time is allowed for transmission of the wireless communications, and more transmission time provides additional operating margin to be sure that, after the vehicle passes a detection module **4**, the safety device **10** then engages before (for example, approximately 30 seconds in advance) the vehicle traveling on the rail reaches the safety device **10**. As one example, the nominal distance of 4,000 feet has been tested and has proved to offer a beneficial operating margin.

[0055] The remote modules **6** are generally installed at the same distance **9** down the track that the detection modules **4** are installed, although the installation location of the remote modules **6** may vary.

[0056] FIGS. **3-6** show a sensing device, also referred to as a detection module (DM) **4**, according to the disclosure. The detection module **4** is designed to reliably detect if a wheel, for example, of a rail vehicle has passed over a specific location on a rail, and if so the detection module **4** may determine the direction and speed at which the vehicle was traveling. It is also possible that the detection module **4** may be configured to detect the presence of another part of a rail vehicle instead of a wheel, for example an axle.

[0057] The detection module **4** is comprised of a sensor package **114**, two discreet magnetic or inductive sensors **102**, signal processing circuitry **104** located near the sensors, a mounting system **106**, and a wire conduit **107** and wire hole **108** to channel wires out of the sensor package **114**. Sensor package **114** includes an upper casing **112** and a lower casing **110** that when affixed together, create a cavity between the two casings **112**, **110**. Sensor package **114** houses, inside this cavity, the signal processing circuitry **104** and the two sensors **102**, along with any hardware required to mount the sensors **102** inside the package **114**, such as brackets, gaskets, screws, washers, etc. Optionally, the sensor package **114** may house other standard components such as an analog-to-digital converter.

[0058] The two discrete sensors **102** of the detection module **4** are mounted, inside the package **114**, at a fixed spacing **116** from each other (see FIGS. **4** and **5**). This spacing **116** allows the two sensors **102** and related circuitry to sense time-separated detection events, allowing for the calculation of the speed and direction of a passing rail vehicle. While the following descriptions discuss only two sensors per detection module, it should be understood that a detection module **4** (and its package **114**) could contain more than two sensors **102**, sometimes referred to as a "sensor array". Additionally, although this disclosure refers separately to sensors **102** and circuitry **104**, it should be understood that there may not be a defined separating point between a sensor **102** and its associated circuitry **104**. For example, the sensor **102** may include, as explain below, a coil of wire and the circuitry **104** may include a signal processing circuit, but the sensor item **102** may also include some or all of the circuit components of circuitry item **104**. If sensor item **102** contains all the circuitry components of item **104** then the two items would, in effect, be one module, including the sensor item **102** and the circuitry item **104**.

[0059] Referring to FIGS. **7-9**, the detection module sensor package **114**, including all of its inner components, is mounted onto a rail **11** (see also FIG. **1**) utilizing a rail attachment device. The rail attachment device can be a clamp, flange, bracket, or other fastener. Preferably, the detection module sensor package **114** is attached to the rail with an energy absorbing mounting system **106**. The mounting system **106** may include a clamp, flange, bracket, or other fastener for attaching the sensor package to a rail **11**. In one example, this mounting system **106** clamps to the lower flange **120** of a rail **11**, and suspends the detection module sensor package **114** up off the rail flange **120** a vertical distance **122**.

[0060] FIGS. **10-11** show a more detailed example of an energy absorbing mounting system **106**. The mounting system **106** may be further comprised of a clamp assembly **124**, aluminum shims **126**, vibration absorption pads **128**, lock pins **130** and cap screws **132**. The detection module sensor package **114** is mounted on top of the absorption pads **128**, which are designed to absorb vibrations from the rail **11**. The absorption pads **128** may be made of a variety of vibration absorbing materials, including rubber or some other elastomeric material. Lock pins **130** are inserted horizontally from the side of the package **114** into the detection module sensor package **114** and rest against the heads of the four cap screws **132**. The cap screws **132** apply clamping force to the package **114** to fasten the package **114** to the rest of the mounting system **106** and to fasten the parts of the mounting system **106** together. In one example, the four cap screws **132** are not tightened conventionally, but are instead tightened to a specific rotation angle after contact is made between the sensor package **114** and the absorption pads **128**. The cap screws **132** are then prevented from unscrewing by the lock pins **130** which are inserted once the mounting system **106** is assembled. The lock pins **130** key on the heads of the cap screws **132**, preventing the cap screws from rotating.

[0061] Referring to FIGS. **7-13**, once the detection module sensor package **114** has been mounted to a rail **11** using a mounting system **106**, for example, the wire conduit **107** has room to freely curve in the gap that exists between the two pillars **123** of the mounting system **106**. The wire conduit **107** attaches to the underside of the lower casing **110** of the package **114** at the location of the wire hole **108** (see FIGS. **5** and **10**). From that point, the wire conduit **107** curves from a generally vertical downward direction to a generally horizontal direction toward the center of the railway **140**. From there, a water-tight tube **142** adapted to enclosing wires attaches to the wire conduit **107**. The tube **142** curves from a generally horizontal direction downward and then back on itself. Tube **142** then runs through a channel **143** created by and between rail ties **141**, below the rail **11**, and then away toward the nearest remote module **6**. The combination of the wire hole **108** (see FIGS. **3-4**), the wire conduit **107** and the tube **142** creates a path whereby wired connections may run from inside the detection module sensor package **114** out to the nearest remote module **6**. Although the preceding explanation refers to specific angles and curving of the wire conduit **107** and tube **142**, it should be understood that other angles, curvings, and wiring paths may work.

[0062] Signal processing circuitry **104** is disposed inside the detection module sensor package **114**, near the sensors. It should be understood that while some processing of the signals produced by sensors **102** may be done by circuitry **104** contained in the detection module sensor package **114**, all or some of the processing may be done by circuitry or firmware contained in the remote module **6**. The sensors **102**, in combination with circuitry generally located inside the detection module **4**, detect the speed of a vehicle travelling on the rail **11** by measuring the time between sensor events. Likewise, the sensors and circuitry measure direction by looking at which sensor event occurred first. A "sensor event" refers to a signal produced by an individual sensor **102** that the circuitry, located either inside the detection module, inside the remote module, or both, determines fulfills the appropriate detection criteria, that is, the circuitry determines whether the detection event is valid.

[0063] Thus, in operation, when a vehicle passes at a distance above the first and second sensors **102** of a detection module **4**, the presence, speed and direction of the vehicle are calculated with circuitry located within the detection module

sensor package **114**, within the remote module **6**, or a combination of both. The detection module **4** produces and sends to the remote module **6** one or more output pulses **323** (see FIG. **20**) predictably synchronized with the passing of the vehicle traveling on the rail. These output pulses **323** are produced utilizing sensors **102** and other circuitry **104** disposed inside the detection module sensor package **114**. In general, a successful sequence of sensor pulses is referred to as a "transit."

[0064] Detection events are generated by the detection modules **4** and/or remote modules **6** at the start and end of a vehicle passing by a detection module **4** on the rail **11**, and the remote module **6** then transmits information about these detection events as signals to the control module **8**. Alternatively, the detection modules **4** and remote modules **6** may generate events and transmit signals for each discrete axle of the vehicle.

[0065] Considering the inner workings of a detection module **4**, sensors **102**, can be one of several different types of proximity sensors, such as Piezo electric sensors, magnetic sensors or inductive sensors. In one embodiment of the disclosure, sensors **102** utilize active inductive sensor technology that is self-compensating and resistant to drift because it constantly resets its trip threshold.

[0066] FIG. **14** shows a high-level circuit diagram of circuitry **203** associated with a sensor **102**. Circuitry **203** constitutes at least some of the total circuitry **104** that is associated with a sensor **102**. Circuitry **203** includes an oscillator **202**, for example a Colpitts oscillator. In general, an oscillator is an electronic circuit that produces a repetitive electronic signal, often a sine wave or a square wave. An oscillator circuit often consists of an inductor and a capacitor connected together in the form of a resonant tank. Charge flows back and forth between the capacitor's plates through the inductor, so the circuit can store electrical energy oscillating at its resonant frequency. However, there are small energy losses in the circuit, and so an amplifier compensates for those losses and supplies the power for the output signal.

[0067] The oscillator **202** operates in continuous wave (CW) mode, for example in the 140-180 kHz range, which is defined by characteristics of the resonant tank comprised of an inductive proximity "pickup coil" **204**, an RF rectifier **208** and an automatic level control (ALC) amplifier **206**. FIG. **15** shows an example of a sinewave, as illustrated by trace **240**, produced by the oscillator **202**. In this example, the sinewave can have a peak-to-peak voltage value of approximately 1.4 Volts and a frequency of approximately 148.8 KHz, which is close to the lower end of the range disclosed above.

[0068] Pickup coil **204**, essentially an inductor, includes wire wound on one half of a ferrite core, a PQ-style ferrite core for example, so that an AC magnetic field generated by the coil extends outward a distance (the coils sensing area), extending above the sensor for example. In this respect, the coil may magnetically couple with nearby metallic objects. It should be understood that other core styles may be used instead of a PQ-style ferrite core. For example, a variant of a "pot core" could be used. A pot core has a magnetic structure that almost completely surrounds the winding of wire, and only small slots are present in the structure to allow wires to enter and/or exit. This magnetic structure tends to contain the magnetic field in a more controlled fashion. Other variants of pot cores that may be applicable to this implementation include ER, DS, RM, and EP cores.

[0069] Construction of the coil is tailored to achieve relatively high Q factor (Quality Factor), which is a measure of energy loss at the operating frequency. Pickup coil **204** preferably utilizes a special type of wire, called "Litz Wire", to achieve high sensitivity and very low power consumption. Litz Wire is comprised of many small-diameter conductors in parallel such that the combined skin effect loss of the conductors is significantly reduced compared to the skin effect loss experienced by other types of wire. Less skin effect loss results in, among other benefits, lower power consumption. More specifically, in regards to the circuitry of the detection module **4**, less skin effect loss results in "low-losses" such that the oscillator achieves a high Q resonance with minimal power. Thus, the use of Litz Wire allows the pickup coil **204** to achieve a Q factor as high as possible.

[0070] Because the pickup coil **204** has a high Q factor when no detection object is present in the pickup coil's sensing area, very little energy needs to be added in each oscillation cycle to sustain oscillations, and thus the micropower operation of the circuitry **203** in "Idle" state (no object detected) is very low (less than 1 milliwatt). In operation, when a metallic object, for example a wheel of a vehicle traveling on a rail **11**, approaches the pickup coil **204** and intrudes the pickup coil's **204** sensing area, the energy loss of the oscillator **202** will increase because some of the energy will be coupled into the object and lost as heat. The amount of energy loss is dependent on both the magnetic properties of the intruding object, and the distance between the pickup coil **204** and the object.

[0071] This increased energy loss exhibits itself as a drop in the Q factor of the pickup coil **204**. As the Q of the pickup coil **204** drops due to approach of an object, the magnitude (i.e. amplitude) of the oscillator's **202** oscillations starts to decrease proportionally. In response, circuit **203** utilizes an ALC loop **207**, consisting of a RF rectifier **208** and an ALC amplifier **206**, to ensure that just enough energy is delivered to the resonant tank of oscillator **202** to sustain oscillations of relatively constant magnitude (i.e. amplitude) for all reasonable values of Q. As the oscillation magnitude (i.e. amplitude) drops, the ALC loop tries to compensate via negative feedback action by producing a DC voltage proportional to the magnitude (i.e. amplitude) of the oscillator's **202** output, which is then amplified and used to control the operating point of the oscillator **202** by increasing the oscillator's **202** operating current. More specifically, a decrease in oscillations magnitude (i.e. amplitude) causes the DC voltage produced by the rectifier **208** to also decrease. In response, the ALC amplifier **206** increases the current through the oscillator's transistor (essentially increasing the amount of energy which is injected into the resonant tank) until the magnitude (i.e. amplitude) of oscillations is back at the predefined level (negative feedback).

[0072] In other words, a reduction in the pickup coil's Q-factor, caused by an intruding object is proportionally represented by an increase in the ALC's drive voltage. The closer the object is to the coil's sensing surface, the higher are the losses due to magnetic coupling, the higher the ALC control voltage will be, while the magnitude (i.e. amplitude) of the RF oscillations remains relatively constant. Therefore, output voltage of the ALC amplifier **206** can be treated as a close representation of the pickup coil's Q, and consequently, representation of the detection object's proximity. For a dynamic

(moving) object, like a railcar wheel, the profile of variations in the ALC control voltage would therefore closely follow the wheel's proximity curve.

[0073] A capacitor **210** is typically located between the ALC control voltage (i.e. the output of amplifier **206**) and amplifier **212**. Capacitor **210** may act as a "DC-blocking capacitor" to the ALC control voltage such that it removes the DC component (DC offset), in whole or in part, from the AC/DC mixture, allowing only (or primarily) the AC component to pass through to amplifier **212**. Thus, the capacitor **210** ensures that only (or primarily) variable signals caused by moving (dynamic) objects are passed downstream in circuitry **203**, while static DC level shifts (drift) that may be caused by interference from static or slow-moving objects (for example, the sensor package or the rail) are blocked, in whole or in part. In this respect, only (or primarily) the AC component of the ALC control voltage variations, which indicates the proximity of a high-speed detection object, is amplified by amplifier **212**.

[0074] In certain embodiments where the circuitry **203**, specifically capacitor **210**, filters out all or some of the DC voltage drift, this filtering feature may provide a benefit over older proximity sensors that may just compare a proximity-based voltage to a static threshold, using the threshold to determine whether an object is sufficiently close. Accounting for DC voltage drift, like the circuitry **203** does in these embodiments, may increase the accuracy and repeatability of the proximity sensing.

[0075] Although the previous description explains a feature whereby the circuitry **203**, specifically capacitor **210**, may completely filter out the DC voltage from the AC/DC mixture, it should be understood that some embodiments may allow some DC voltage to pass downstream. In these embodiments, the ability to sense the DC aspect, or at least very low frequency components, may be useful.

[0076] While the circuit **203** is in its "Idle" state (no object detected), the profile of the V_Q voltage **214** is a flat line, close to the circuit's virtual ground level. The threshold of comparator **216** is chosen such that the ENABLE signal **218** (i.e. the output of comparator **216**) is inactive in the "Idle" state, holding the output **228** of the flip-flop **220** in a "Reset" state and the storage capacitor **222** of the peak-and-hold circuit **224** discharged.

[0077] In operation, the passing of a railcar wheel above the pickup coil **204** introduces a bell-shaped variation in the V_Q voltage **214**. In order to provide consistent synchronization of the output pulses **323** with the top of the bell-shaped voltage curve (which coincides, for example, with a wheel's closest location), circuitry **203** utilizes a peak-and-hold detector, whereby the following sequence of events transpires in circuitry **203**: (1) As soon as the V_Q voltage **214** rises significantly above the noise level of the Idle state, comparator **216** raises the ENABLE signal **218** and keeps it active until the V_Q voltage **214** falls back under the detection threshold, which occurs as the detection object recedes. (2) The active ENABLE signal **218** activates in turn the peak-and-hold circuit **224** by connecting its storage capacitor **222** to the output of the peak detector **226** in the peak-and-hold circuit **224**. Also, flip-flop **220** is released from the "Reset" state (however, the state of output **228** does not change until a trigger pulse is generated by comparator **230**). Differential driver **232** is also activated at this point. (3) On the rising slope of the V_Q voltage **214**, the output (V_PEAK) **234** of the peak-and-hold circuit **224** follows the V_Q voltage **214** closely, with a slight lag. Comparator **230** maintains its low output state, since the V_Q voltage **214** input to the comparator **230** is always slightly above the V_PEAK **234** input.

[0078] (4) When the V_Q voltage **214** tops off (i.e., the top of the bell-shaped voltage curve) and begins to fall back, the peak-and-hold circuit **224** can no longer follow it and holds the maximum level that V_Q voltage **214** has reached in this detection cycle. As soon as the divergence between the falling V_Q voltage **214** and the "frozen" V_PEAK **234** becomes large enough to overcome the hysteresis of the comparator **230**, the comparator's **230** output state changes, producing a trigger pulse for the flip-flop **220**. (5) Flip-flop **220** then changes its output state to "high", producing a pulse at its output **228**, which is further converted to differential format by the differential driver **232**. (6) This state is preserved until the V_Q voltage **214** drops below comparator's **230** detection threshold, which then terminates the flip flop's **220** output pulse and resets the circuit back into its "Idle" state, whereby circuitry **203** is ready for a next detection event. FIG. **18** shows an example of the output pulses **323** that result from the detection of a metallic object by the circuitry **203**. The trace labeled **250** corresponds to one of the outputs of the differential driver **232** while the trace labeled **252** corresponds to the other output of the differential driver **232**.

[0079] Referring to FIG. **16**, there is shown an example of the timing relationship that results between the V_Q voltage **214**, which is illustrated by trace **242**, and one of the output pulses **323**, which is illustrated by trace **244**, when the sequence of events described above transpires in circuitry **203**. In this example, when a metallic object passes above the pickup coil **204** at a distance of approximately two inches (2"), the start of the pulse in trace **244** coincides with the peak of the bell-shaped curve of trace **242**. In other words, the output pulse **323** that is generated indicates, by its starting time, the peak of the V_Q voltage **214** and, therefore, the moment at which the metallic object is closest to the sensor **102**.

[0080] In the event that the oscillator **202** malfunctions or operates incorrectly because of a damaged inductive proximity pickup coil **204** or other defects that lead to a loss in oscillations, the voltage of the ALC loop will likely rise to the maximum or close to the maximum of the operating voltage range. The circuitry **203** can be configured to detect those instances, and when detected, circuitry **203** can be configured to force both outputs **323** from the differential driver **232** to zero (or another defined state), and generate a signal that indicates that a fault in the oscillator **202** has been detected.

[0081] With respect to the embodiment of circuitry **203** associated with sensor **102** illustrated by FIG. **14**, the oscillator **202** can be built around a first transistor Q1 (not shown) and a voltage-controlled resistor (not shown) in the emitter path of Q1. The voltage-controlled resistor can be implemented using a second transistor Q2. The sinewave produced by the oscillator **202** is converted to DC by the RF rectifier **208** and applied to the input of the ALC amplifier **206** in such a polarity that an increase in the magnitude (i.e. amplitude) of oscillations results in a decrease in the output of the ALC amplifier **206** (V_ALC), thus reducing the conductance of the voltage-controlled resistor. Similarly, a decrease in the magnitude (i.e. amplitude) of oscillations results in an increase in the output of the ALC amplifier **206**, which increases the conductance of voltage-controlled resistor. Therefore, any drop in the Q factor of the inductive proximity pickup coil **204** in response to the presence of a nearby metallic object can be

compensated by the ALC loop by increasing the conductance of the voltage-controlled resistors, which reduces the emitter resistance in Q1. Since the base of Q1 can be kept at a fixed reference potential, a reduction of emitter resistance can cause the DC operating point to move such that there is an increased current draw and more energy is deposited into the resonant tank at each cycle. A thermally sensitive resistor (not shown), also referred to as a thermistor, can be used with the oscillator **202** to maintain the voltage of the ALC loop at approximately the middle of the operating voltage range during "Idle" operation.

[0082] Also with respect to the embodiment of circuitry **203** illustrated by FIG. **14**, the amplifier **212** can be configured or be operable to have a sufficiently high gain, for example 30 dB at 25 degrees Centigrade, so that small variations in the output of the ALC amplifier **206** can be amplified by the amplifier **212** to an magnitude (i.e. amplitude) of approximately a few hundred millivolts during normal detection events. A thermistor (not shown) associated with the amplifier **212** can compensate or neutralize the effect that the thermistor in the oscillator **202** has on the overall gain of the analog track of the circuitry **203**.

[0083] Moreover, because of the high gain of the amplifier **212**, if the sensor **106** is mounted so that the wheels pass very close to the pickup coil **204**, the output from the ALC amplifier **206** can cause the output of the amplifier **212** to saturate, clipping V_Q voltage **214**. Such clipping could cause the generation of incorrectly positioned differential output pulses **323**. To address this possible condition, a Zener diode (not shown) can be placed in a feedback path of the amplifier **212** to give it a logarithmic transfer characteristic for large-magnitude (i.e. large-amplitude) signals. As a result, a strong proximity voltage signal would be somewhat flattened at the top instead of being hard-clipped, allowing for correct operation of the follow-up peak detection. FIG. **17** shows an example of the timing relationship that results between the V_Q voltage **214**, which is illustrated by trace **246**, and one of the output pulses **323**, which is illustrated by trace **248**, when a metallic object passes above the inductive proximity pickup coil **204** at a distance of less than one inch (1"). In such instance, the logarithmic transfer characteristics of the amplifier **212** flatten the top of the V_Q voltage **214** such that the synchronization of the output pulse **323** and the V_Q voltage **214** is not exact but produces an acceptable result.

[0084] FIGS. **19**A and **19**B show the remote module (RM) **6**. The primary function of the remote module **6** is to receive and process signals received from the detection module **4** and to send appropriate signals to the control module **8**. The remote module **6** includes 2 main subcomponents, a connection box **306** that is typically located close to the tracks, and a utility pole **308** that is typically located further away from the tracks and connected by an underground connection (see FIG. **22**) to the connection box **306**.

[0085] Referring to FIG. **19**A, the connection box **306** may contain a junction box **311** and a control board **307**, preferably enclosed in an environmentally sealed enclosure. Referring to FIG. **19**B, the control board **307** may also be mounted, preferably within an environmentally sealed enclosure, on the utility pole **308**, further away from the tracks, instead of being disposed inside a structure (for example, connection box **306**) that is mounted close to the tracks.

[0086] The junction box **311** contains mainly adaptors and connections to create a removable connection to the detection module **4**, which aids in the installation and removal of the detection module **4**, for example, removal of the detection module **4** to perform track maintenance. It should be understood that although FIG. **19**A shows the junction box **311** contained within a structure (for example, connection box **306**) that also contains the control board **307**, the connections of the junction box **311** and the junction box itself may be contained either inside the structure that houses the control board **307**, outside that structure, or a combination of both. Additionally, referring to FIG. **19**B, in the example where the control board **307** is mounted on the utility pole **308**, the junction box **311** may be the only component located near the tracks, such that the junction box **311** is not actually contained within a separate box (for example, connection box **306**) as shown in FIG. **19**B, but instead the junction box **311** would stand alone as the only module near the tracks, such that it is directly connected to the utility pole **308**.

[0087] Referring to FIG. **20**, the control board **307** contains most or all of the circuitry components contained within the remote module **6**. In one example, all of the circuitry components of the remote module **6** are disposed on a single circuit board. The control board **307** can contain circuitry **314** adapted for processing signals received from the detection module, a wireless radio transmitter circuit **316**, a power module **318**, and a monitoring and control module **320**. The circuitry **314** is in connection with the detection module **4** (see FIG. **20**) and further includes signal detecting and control logic, a timer, and signal processing and filtering logic. The circuitry **314** is also in communication with the radio transmitter circuit **316**, and may send it vehicle presence, speed and direction information of a nearby vehicle. The radio transmitter circuit **316** is in connection with a radio transmitter antenna **310**, located on the utility pole **308**. The power interface **318** may be connected to power components contained on the utility pole **308**, including one or more solar panels, battery packs or both. Furthermore, the power interface **318** may contain power monitoring and charging logic as well as a power supply to power the other components contained in the connection box **306** and optionally to feed power to the detection module **4**. The monitoring and control module **320** further contains a service interface and a system monitoring and control unit that may communicate system information (for example, diagnostics about the detection module and the remote module) to the radio transmitter **316**.

[0088] It should be understood that while some processing of the detection module sensor signals may be done inside the detection module sensor package **114**, all or some of the processing may be done by circuitry contained in the remote module **6**. Typically, the detection module produces one or more output pulses **323** predictably synchronized with passing of a vehicle on the rail. Then circuitry inside the detection module **4** or inside the remote module **6** or both computes whether the signals generated by the detection module sensors fulfill the appropriate detection criteria, that is, whether a vehicle detection event is valid. Detection events are generated by the detection modules and remote modules at the start and end of a vehicle traveling on the rail, and the remote modules transmit these detection events as signals to the control module. Alternatively, the detection modules and remote modules may generate events and transmit signals for each discrete axle of the vehicle.

[0089] FIG. **19**A shows a utility pole **308**, which includes a wireless radio transmission antenna **310**, a solar panel **312**, and battery packs **322**. It should be understood that even though this disclosure and FIG. **19**A refers to a utility "pole"

308, the utility pole **308** is actually comprised of a physical pole **309** as well as the devices that are mounted to the pole **309**, such as the wireless radio transmission antenna **310**, the solar panel **312**, and the battery packs **322**. Throughout this disclosure, the phrase "on the utility pole **308**" shall be understood to mean either mounted on the physical pole **309** or located in close vicinity to the physical pole **309**. Additionally, a variety of styles of physical poles may be used, such as a hinged metal pole that allows erection of the antenna and solar panel without requiring a lift truck, such that all work on the mounted components can be done at ground level.

[0090] The solar panel **312** derives energy from the environment, and stores that energy in the battery packs **322** or other rechargeable batteries. The battery packs **322** are enclosed in a vented enclosure that is adapted to be mounted on a pole. Furthermore, the battery packs **322** are sized for over 30 days of operation in the event the solar cell is damaged or otherwise incapacitated. Together, the solar panel **312** and the battery packs **322** provide power to the other modules that make up the remote module and detection module.

[0091] Referring to FIG. **20**, the transmitter **324**, which includes a radio transmission antenna **310** and a radio transmitter circuit **316**, processes signals generated by the remote module **6** and transmits signals to control module **8** utilizing either a wired or a wireless communication. For example, a wireless communication could be established by a frequency hopping radio, transmitting at a radio frequency (RF) such as a 900 Mhz band. In another example, a wireless communication could be established using a wider cellular interface and cellular network. Frequency hopping radios are preferable for wireless communications over a distance of three miles or less. For longer distances, it may be preferable for the wireless communication to be established over licensed frequencies that allow higher power transmissions than are allowable on unlicensed frequencies. Additionally, for longer distances, the wireless communication may be established by an interface to a cellular network.

[0092] Transmitter **324** is mainly referred to, throughout this disclosure, as a "transmitter" because it typically operates to transmit signals. Likewise, transmission antenna **310** and transmitter circuit **316** typically operate to transmit signals. However, it should be understood that transmitter **324**, transmission antenna **310** and transmitter circuit **316** may also operate to receive signals, and in this respect they may actually be transceiver components. Thus, it should be understood that although these components (**324**, **310**, **316**) are referred to throughout this disclosure as "transmitter" or "transmission" components, they may actually be transceiver components.

[0093] One benefit of the wireless antenna and solar panel features of this embodiment is that installation of the rail line sensing and safety system **2** is much easier than if, for example, wired connections had to be run from the remote module to the control module or from a power source to the remote module. This wireless and solar powered installation is especially useful in remote locations where currently, installing rail sensing systems is cost prohibitive due to lack of power and interface infrastructure.

[0094] Although the wireless installation is often preferred, in certain instances, it may be desirable to install a "wired" version of the rail line sensing and safety system **2**. This wired version may be preferable in certain environments or circumstances where the wireless space is "noisy" or where other obstructions may attenuate a wireless signal or link In this wired configuration, the wireless radio links **14** (the wireless radio transmitter **324** and the wireless radio transceiver **405** are replaced by wired connections, for example, utilizing a twisted wire pair and differential drivers, such as EIA-485. Likewise, in a wired configuration, the solar panels **312** and battery packs **322** on the utility pole **308** may be eliminated, and instead, DC power may be fed to the remote modules and detection modules through the wired connection from the control module, for example, utilizing a wire pair as the wired connection. In the wired installation, the power supply at the control module may still include solar panels and battery packs, or may include a more permanent power supply from a power generator.

[0095] The remote module **6** may also utilize power saving features. For example, the remote module **6** may operate in a mode whereby processing circuitry, for example circuitry included on control board **307**, is at times put to "sleep." Because the wireless transmitter **324** in the remote module **6** has sufficient built-in intelligence to maintain a wireless link without requiring constant transmission and processing of substantive signals about vehicles, the processing circuitry in the remote module **6** may sleep when there is inactivity in the system. The wireless link is maintained autonomously while the processing circuitry is powered down. If the remote module **6** needs to communicate substantively with the control module **8**, for example with a status update or a detection of a vehicle on the rail, the processing circuitry in the remote module **6** may be signaled to "wake up."

[0096] FIGS. **21** and **22** show the installation location of the main remote module subcomponents (connection box **306** and utility pole **308**) in relation to a rail line **11**, a detection module **4** and each other. The connection box **306** and utility pole **308** are each located a distance **330**, **332** (respectively) away from the center line of the rail **334** in a perpendicular direction to the center line **334**. Distances **330** and **332** may vary. The utility pole **308** may be installed a distance away from other remote module components (located in the connection box **306** near the rail **11**) if, for example, there is not enough space near the rail **11** to install the utility pole **308**, with its antenna, battery packs and a solar panels. Other factors that may determine the location of the utility pole include the need to establish a sufficient wireless link and the need for access to direct sunlight. In one example, the connection box **306** is located a distance **330** of approximately 8 feet from the rail, and the utility pole **308** is located a distance **332** of approximately 25 feet from the rail.

[0097] The connection box **306** and the utility pole **308** are installed at approximately a distance **9** (see FIGS. **1** and **21**) down the track from the centerline **7** between the two safety devices **10**, approximately the same distance **9** at which the detection modules are installed. This distance is typically between 3,800 feet and 4,500, although other distances may allow the system modules to function properly.

[0098] Referring to FIG. **22**, the connection box **306** and the utility pole **308** are connected by an underground conduit **339**. The conduit may run in a variety of directions, angles and depths. Additionally, the conduit may be formed from a variety of materials such as metal, plastic and PVC. Furthermore, the conduit may be formed from a single piece of material, or from several segments joined together. In the example shown in FIG. **22**, the conduit starts at the connection box **306** and extends, by a PVC segment **340**, vertically downward below the line of the ground **350**. At approximately a depth of 3 to 4 feet, PVC segment **340** connects by a 90 degree elbow **346** to

another PVC segment **342**. PVC segment **342** runs horizontally toward the utility pole **308**, and once it reaches the utility pole **308**, it connects by a 90 degree elbow **347** to another PVC segment **344**. PVC segment **344** runs vertically upward and meets the utility pole **308** at its base.

[0099] FIG. **23** shows the control module (CM) **8**, the central control center for the rail line sensing and safety system **2**. The main purpose of this module is to process signals transmitted from the remote module's and then control a safety device **10**, either directly (see FIG. **24**) or indirectly (see FIG. **23**) as a backup or supplement to an existing sensing and safety system (ESSS). Typically, the rail line sensing and safety system **2** contains only one control module, but it may contain more than one, for example, one for each side of the safety device **10**. Although the following discussion refers to a single control module, it should be understood that there could be more than one.

[0100] According to FIG. **23**, the control module **8** is comprised of at least two radio transceiver antennas **402**, typically one to receive signals from each remote module **6** located on opposite sides of the safety device **10**. In general, signals transmitted and received from antennas travel directionally (as opposed to omni-directionally), and because typically at least one remote module **6** is located down the track on each side of the control module **8**, the signals sent by the remote modules **6** are typically received by the control module **8** from opposite directions. Thus, the rail line sensing and safety system **2** typically utilizes two antennas so each can be pointed directly toward its associated remote module **6**.

[0101] The control module **8** further comprises a wireless transceiver circuit **404**, a signal and data processing circuit **406**, a monitoring and control module **408**, a safety system interface **410**, and a power supply **412**. The wireless transceiver circuit **404** further contains a splitter/combiner that combines (or selects) the signals from (or between) multiple radio transceiver antennas **402**, a radio transceiver such as a base FHSS radio transceiver, a communication management circuit and optionally a cellular link and a GPS module. The wireless transceiver circuit **404** together with a radio transceiver antenna **402** constitutes a wireless transceiver **405** that communicates with the wireless transmitter **324** of a remote module **6**, typically to receive signals sent from the remote module **6** to the control module **8** (see FIG. **1**).

[0102] The signal and data processing circuit **406** further contains a real-time clock which may have a WWV receiver for automatic time synchronization, and a data processor circuit that processes signals from the remote modules regarding vehicles traveling on the rail. (Note: WWV is the call sign of the United States National Institute of Standards and Technology's shortwave radio station, and WWV continuously transmits official U.S. Government frequency and time signals.) The monitoring and control module **408** further contains a user interface, a service interface such as a microSD slot, USB port or Ethernet port, a configuration management module and a data and event logging module. The data and event logging module may log system information and diagnostic about remote modules as well as the control module itself. The power supply **412** may contain power handling circuitry including a temperature compensated circuit for transferring power from solar panels to a rechargeable battery.

[0103] The control module **8** receives vehicle detection events from the remote modules **6** which include time-stamped track identification, and information about the presence, speed, and direction of vehicles traveling on the rail. Detection events are generated by the detection modules and remote modules at the start and end of a vehicle traveling on the rail, and the remote modules **6** transmit these detection events as signals to the control module **8**. Alternatively, the detection modules and remote modules may generate events and transmit signals for each discrete axle of the vehicle.

[0104] The control module data processor circuit **406** analyzes and validates incoming detection events and determines whether to generate a signal to a safety device (either directly or indirectly), such as a signal to lower a gate or activate an alarm (see FIG. **23**). The control module data processor circuit **406** also may contain fault detection functionalities whereby it recognizes and logs anomalous combinations of events which may or may not indicate an error or other failure in the rail line sensing and safety system **2**. For example, if the control module detects an outbound vehicle (at the detection module on one side of the safety device) with no associated inbound detection (at the detection module on the other side of the safety device), an error or a "fault" may exist in the system.

[0105] The rail line sensing and safety system **2** may also incorporate this fault detection functionality at the sensor level. In this example, the signals detected from one of the sensors inside a detection module package is compared to the signals detected from the other sensor inside the same detection module package. Circuitry located inside the detection module, the remote module, the control module or some combination of these, compares the signals from each of the sensors within a detection module package and recognizes and logs anomalous combinations of events. For example, if one of the sensors within a detection module package is indicating a nearby, large, fast-moving object and the other sensor in the same package is outputting no signal, an error or a "fault" may exist in detection module package or in the system.

[0106] In one embodiment of the disclosure, the control module **8** is mounted inside an existing control bungalow **9** (see FIGS. **1** and **23**) located on either side of a safety device **10** (for example, crossing gates). One benefit of this type of mounting is that installation is easy because no additional housings need to be built to contain the control modules. Additionally, it may be possible for the existing power source inside the control bungalow **9** to feed power to the control module **8**. The existing power source may, for example, come from the existing sensing and safety system.

[0107] Referring to FIG. **24**, if the control module **8** is unable to receive power from an existing power source, the control module may contain its own power module **420**. Power module **420** may contain solar panels, battery packs or both. The solar panels may be mounted on a pole, similar to the setup of the utility pole **308** or the remote module **6**. The same pole may also support the radio transceiver antennas **402**.

[0108] The control module **8** and/or the remote module **6** may also utilize power saving features. For example, because the wireless transceiver (in the control module **8**) and/or the wireless transmitter (in the remote module **6**) may draw a large amount of current, the control module **8** and/or the remote module **6** may operate in a mode where the transceiver (in the control module **8**) and/or the wireless transmitter (in the remote module **6**) is normally powered down ("sleep mode") and where the transceiver and/or transmitter are "woken up" and synchronize each time a vehicle is detected.

However, it should be noted that if the transceiver and/or transmitter synchronization takes too long after the transceiver and/or transmitter is "woken up", such that system integrity (i.e. there is concern that the synchronization will not complete before the vehicle reaches the safety device) becomes a concern, the control module **8** and/or the remote module **6** may operate in a mode where the wireless transceiver and/or wireless transmitter are operational ("awake") at all times.

[0109] Another example of a power saving feature that the control module **8** and/or the remote module **6** may utilize is a mode of operation where the control module **8** and/or the remote module **6** puts its main control processor to "sleep." Because the wireless transceiver (in the control module **8**) and/or the wireless transmitter (in the remote module **6**) have sufficient built-in intelligence to maintain a wireless link without requiring constant transmission and processing of substantive signals about vehicles, the main control processor in the control module **8** and/or the remote module **6** may sleep when there is inactivity in the system. The wireless link is maintained autonomously while the main processor is powered down. If the remote module **6** requires any substantive communication with the control module **8**, such as a status update or a detection of a vehicle on the rail, it can wake up its own processor and/or signal to the control module **8**, through the wireless radio link, to wake up its processor.

[0110] Referring to FIG. **23**, in one embodiment, the rail line sensing and safety system **2** is installed as a backup or supplemental system to an existing sensing and safety system (ESSS) **414**. In this embodiment, the control module **8** may interface with the card racks that are currently available inside the existing control bungalow **3**. For example, the control module may plug into existing auxiliary inputs of the existing sensing and safety system. In operation, if the existing sensing and safety system either fails completely to detect an incoming train or is late in lowering the gates, the backup/supplemental system will provide an input signal to lower the gates, and then the existing sensing and safety system may activate and control the gates.

[0111] Referring to FIG. **24**, in another embodiment, the rail line sensing and safety system **2** is installed as a primary control to a safety device **10** that may include gates, bells, lights, etc. In this embodiment, the control module **8** interfaces directly with the safety device **10**, whereby the control module **8** interfaces with the safety device **10** such that the control module **8** instructs the safety device **10** to engage. For example, the control module **8** may directly instruct the safety system **10** to lower its gates.

[0112] As explained above, and considering FIG. **1**, the rail line sensing and safety system **2** may have a single detection module **4** mounted a distance down the rail on each side of the safety device **10**. Furthermore, as explained above, the rail line sensing and safety system **2** may have, one per side, a single radio link, including a transmitter located in the remote module **6** and transceiver located in the control module **8**.

[0113] Alternatively, and considering FIG. **2**, the rail line sensing and safety system **2** may be configured with added redundancy **20**. The added redundancy **20** may consist of at least one additional detection module **22** mounted a distance down the rail **11** on each side of the safety device **10**, such that each side has at least 2 detection modules **4, 22**. Additionally, the added redundancy **20** may consist of at least one additional radio link **24** (transmitter and transceiver) on each side of the safety device **10**. Each redundant radio link may operate on a different frequency than the initial radio link. Although the redundancy **20** is portrayed and explained as only one additional detection module per side and one additional radio link per side, it should be understood that the redundancy could be increased to include more than one detection module per side and more than one radio link per side. Additionally, the redundancy could include duplicates of other parts of the rail line sensing and safety system **2**, to further enhance the reliable detection of light, fast-moving vehicles.

[0114] The redundancy **20** may be especially important if the rail line sensing and safety system **2** is installed as the primary control to a safety device **10**, as shown in FIG. **24** and as explained above. In this embodiment, the rail line sensing and safety system **2** replaces an existing sensing and safety system completely or is installed instead of a more expensive system. Because no other sensing and safety system is installed, the redundancy **20**, importantly, enhances the reliability of the detection modules and the radio links, such that the safety device **10** activates when a vehicle travels on the rail past the detection modules.

[0115] Although the redundancy **20** may be especially preferred when the rail line sensing and safety system **2** is installed as the primary control to a safety device **10**, it may also be used in the embodiment (shown in FIG. **23** and explained above) where the rail line sensing and safety system **2** is installed as a backup or a supplement to an existing sensing and safety system. In this setup, the redundancy **20** acts as an additional layer of backup.

[0116] Regardless of whether the rail line sensing and safety system **2** is configured as a primary control to a safety device, or as a backup/supplement to an existing sensing and safety system, and regardless of whether the rail line sensing and safety system **2** is configured to included redundancies, the rail line sensing and safety system **2** provides several advantages over existing/current railroad sensing and safety systems.

[0117] It should be understood in regards to the following descriptions of an "existing system" or a "current system" that these current systems as described are examples of systems that the rail line sensing and safety system **2** of this disclosure may backup or supplement in the embodiment described herein where the rail line sensing and safety system **2** is configured to backup or supplement an existing sensing and safety system. Thus, the existing sensing and safety systems described in this disclosure may be similar to the current system described as follows, including the disadvantages of the current system.

[0118] The advantages of the rail line sensing and safety system **2** over the current system can be seen by looking at how the current system in use at many railroad crossing locations detects an approaching train. The current system sends an electrical signal down a rail, whereby the rail is used as a conductor for the signal to travel through. When a train approaches, the signal is shorted by a metallic wheel of the approaching train. This shorting requires that an electrical contact be made between the metallic rail and the metallic wheel. The change in the signal due to this shorting is then processed by the system to determine if a train is present, and if so, the system signals the crossing gates to lower.

[0119] There are several drawbacks to the current system that are not present if the rail line sensing and safety system is used. One drawback to the current system is that due to "interference" (for example, corrosion of the rail, weather or

other environmental factors), the wheel of the train may not contact the rail with sufficient contact force to establish the required electrical connection between the wheel and the rail. In the best case scenario, this interference causes inconsistent readings in the system. In the worst case scenario, the system does not detect the approaching train and the crossing gate is never lowered. In the current system, attempts are sometimes made to improve consistency by adding additional axles (cars) to the train to add additional electrical contacts as well as additional weight and additional contact force. However, these extra cars often travel empty.

[0120] Another drawback to the current system is that the rated speed at which it can operate (i.e. at which trains can travel) is relatively low, currently limited to between 60 and 80 miles-per-hour. The current system requires this lower speed because, at a lower speed, the chances are higher of establishing the required electrical connection between the wheel and the rail.

[0121] The rail line sensing and safety system **2** does not suffer from the disadvantages of the current system. Interference with an electrical connection between the wheel and the rail is not an issue in the rail line sensing and safety system because the rail line sensing and safety system utilizes an advanced induction proximity sensor. This proximity sensor does not rely on the rail as a conductor and operates reliably even if the rail is contaminated. Therefore, by using the rail line sensing and safety system, the vehicles traveling on the rail need not carry additional empty cars nor limit their speed.

What is claimed is:

1. A sensing device for a rail line comprising:

a first sensor capable of detecting a vehicle traveling on the rail line and signaling a first detection event;

a second sensor capable of detecting the vehicle traveling on the rail line and signaling a second detection event, wherein the second sensor is located a fixed distance away from the first sensor;

electrical circuitry that accepts signals from the two sensors; and

electrical connections that electrically connect the two sensors and the electrical circuitry.

2. The sensing device of claim **1** wherein the first sensor and the second sensor are inductive sensors, each sensor comprising wire wound on a ferrite core,

and wherein the wire is Litz Wire,

and wherein each sensor is capable of generating a magnetic field that extends a distance above the sensor,

and wherein the electrical circuitry is capable of detecting an interruption in the magnetic field of either the first sensor, the second sensor, or both.

3. The sensing device of claim **2** wherein the ferrite core is a PQ-style ferrite core.

4. The sensing device of claim **1**, wherein each of the first sensor and the second sensor comprises a coil of wire operable to inductively couple to at least one part of the vehicle traveling on the rail line,

and wherein the electrical circuitry is configured to generate, for the first sensor, a first coupling signal and a first output pulse signal,

the magnitude of the first coupling signal being based on the amount of inductive coupling between the coil of wire of the first sensor and the vehicle,

the first output pulse signal being an output pulse triggered in response to the first coupling signal indicating that the amount of inductive coupling between the coil of wire of the first sensor and the vehicle is approximately at a maximum,

and wherein the electrical circuitry is configured to generate, for the second sensor, a second coupling signal and a second output pulse signal,

the magnitude of the second coupling signal being based on the amount of inductive coupling between the coil of wire of the second sensor and the vehicle,

the second output pulse signal being an output pulse triggered in response to the second coupling signal indicating that the amount of inductive coupling between the coil of wire of the second sensor and the vehicle is approximately at a maximum.

5. The sensing device of claim **4**, wherein, for each of the first sensor and the second sensor, as the vehicle gets closer to the sensor's coil of wire, the amount of inductive coupling between the coil of wire and the vehicle increases and the Q factor of the coil of wire decreases,

and wherein the magnitude of the coupling signal increases when the amount of inductive coupling between the coil of wire and the vehicle increases.

6. The sensing device of claim **4**, wherein the first output pulse signal generated by the circuitry for the first sensor corresponds to the signaling of the first detection event, and the second output pulse signal generated by the circuitry for the second sensor corresponds to the signaling of the second detection event.

7. The sensing device of claim **4**, wherein the electrical circuitry comprises, for each of the first sensor and the second sensor, a peak-and-hold detector that is operable to:

detect a peak in the magnitude of the coupling signal, and

trigger the output pulse signal when the peak in the magnitude of the coupling signal is detected.

8. The sensing device of claim **7**, wherein the electrical circuitry comprises, for each of the first sensor and the second sensor, a capacitor located between the wire carrying the coupling signal and the peak-and-hold detector,

and wherein the capacitor removes a DC component of the coupling signal, allowing only an AC component of the coupling signal to pass through to the peak-and-hold detector,

and wherein the capacitor ensures that static DC-signal drift in the coupling signal is not introduced to the peak-and-hold detector.

9. The sensing device of claim **4**, wherein the electrical circuitry comprises, for each of the first sensor and the second sensor, an amplifier operable to amplify the coupling signal, the amplifier comprising a feedback path having a Zener diode to produce a logarithmic transfer characteristic of the amplifier such that the amplifier is capable of accurately handling the coupling signal regardless of whether its magnitude is large or small.

10. The sensing device of claim **4**, wherein the electrical circuitry comprises, for each of the first sensor and the second sensor, a comparator operable to terminate the output pulse when the magnitude of the coupling signal falls from a peak magnitude to below a threshold value.

11. The sensing device of claim **4**, wherein the electrical circuitry for each of the first sensor and the second sensor is operable to detect an error or a fault in the electrical circuitry and to generate an error signal when the error or fault is detected.

12. The sensing device of claim 1, further comprising a sensor package that houses at least the two sensors, the electrical circuitry and the electrical connections,

wherein the sensor package includes an upper casing and a lower casing such that when the two casings are affixed together, a cavity is defined between them,

wherein the sensor package includes an attachment device for attaching the sensor package to the rail line.

13. The sensing device of claim 12 wherein the attachment device is an energy absorbing mounting system comprised of:

a clamp assembly for attaching the sensor package to the rail line;

aluminum shims and vibration absorption pads disposed between the sensor package and the clamp assembly,

wherein the vibration absorption pads are composed of rubber or an elastomeric material or other vibration absorbing material;

cap screws that run vertically through the sensor package, the aluminum shims, the vibration absorption pads, and into the clamp assembly,

wherein the cap screws apply clamping force to attach the sensor package to the rest of the attachment device and to hold the parts of the attachment device together; and

lock pins that are inserted horizontally into the side of the sensor package to prevent the cap screws from rotating.

14. The sensing device of claim 1, wherein the electrical circuitry includes a signal processor.

15. The sensing device of claim 14 wherein the signal processor is programmed to calculate the direction, speed or both of the vehicle traveling on the rail line by detecting the order of the first detection event in relation to the second detection event, and measuring the time period between the detection events.

16. The sensing device of claim 1, further comprising:

at least one additional sensor capable of detecting the vehicle traveling on the rail line and signaling at least one additional detection event,

wherein the electrical circuitry also accepts signals from the at least one additional sensor,

wherein the electrical connections also electrically connect the at least one additional sensor.

17. A rail line sensing and safety system comprising:

at least one sensing device for a rail line according to claim 1,

wherein each sensing device outputs one or more signals that indicate at least one of the presence, direction and speed of a vehicle traveling on the rail line;

at least one remote module that accepts signals outputted by at least one of the sensing devices,

wherein the remote module processes signals and transmits one or more signals,

wherein the remote module is located near the sensing device from which it accepts signals; and

a control module that accepts signals outputted by at least one of the remote modules,

wherein the control module performs operations based on signals and outputs one or more signals,

wherein the signals outputted by the control module indicate, among other things, whether one or more safety devices should be activated, the safety devices being lights, gates, bells, visual, audio or physical warnings, and combinations thereof,

wherein the control module and the safety devices are located near an intersection of a rail line and a road, a second rail line, or other path of travel.

18. The rail line sensing and safety system of claim 17 further comprising:

one or more solar panels electrically connected to one or more devices or modules, including the sensing device, the remote module and the control module; and

one or more battery packs electrically connected to one or more devices or modules, including the sensing device, the remote module and the control module.

19. The rail line sensing and safety system of claim 17 wherein the signals outputted by the control module are sent directly to the one or more safety devices, and wherein the rail line sensing and safety system provides primary control signals for the safety devices.

20. The rail line sensing and safety system of claim 17 wherein the sensing and safety system is adapted to be a supplemental or backup system to a separate existing system,

and wherein the signals outputted by the control module are sent to the existing system,

and wherein the existing system controls one or more safety devices.

21. The rail line sensing and safety system of claim 20 wherein the existing system attempts to detect the vehicle traveling on the rail line by sending one or more electrical signals down one or more rails of the rail line,

whereby the rail operates as a conductor for the one or more signals to travel through.

22. The rail line sensing and safety system of claim 19 further comprising at least one backup sensing device,

wherein at least one sensing device located on either side of the safety devices is backed up, as a form of redundancy, by the at least one backup sensing device,

wherein the backup sensing device is located a distance away from the sensing device that it backs up,

wherein the backup sensing device outputs signals that indicate at least one of the presence, direction and speed of a vehicle traveling on the rail line.

23. The rail line sensing and safety system of claim 20 further comprising at least one backup sensing device,

wherein at least one sensing device located on either side of the safety devices is backed up, as a form of redundancy, by the at least one backup sensing device,

wherein the backup sensing device is located a distance away from the sensing device that it backs up,

wherein the backup sensing device outputs signals that indicate at least one of the presence, direction and speed of a vehicle traveling on the rail line.

24. The rail line sensing and safety system of claim 17 further comprising at least one sensor that monitors health of at least one device or module in the system, including the sensing device and the remote module,

wherein the signals transmitted by the remote module and sent to the control module periodically include information regarding health of at least one device or module,

wherein the control module is adapted to accept signals and information regarding health of devices or modules.

25. The rail line sensing and safety system of claim 17 wherein the control module includes computing equipment capable of data logging and self-diagnostics.

26. The rail line sensing and safety system of claim 17 further comprising a display that is part of the control module, wherein the display conveys system diagnostics and status indicators.

27. The rail line sensing and safety system of claim 17 wherein the remote module transmits one or more signals using a frequency hopping radio.

28. The rail line sensing and safety system of claim 17 wherein the remote module transmits one or more signals using a cellular network.

29. The rail line sensing and safety system of claim 17 wherein the remote module transmits one or more signals using a licensed frequency.

30. The rail line sensing and safety system of claim 17 wherein the sensing device is located a distance away from the one or more safety devices that the sensing and safety system controls,

wherein the distance is between 3,800 feet and 4,500 feet.

* * * * *

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(54) **RAIL CROSSING REMOTE DIAGNOSTICS**

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(21) Appl. No.: **13/855,118**

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Related U.S. Application Data

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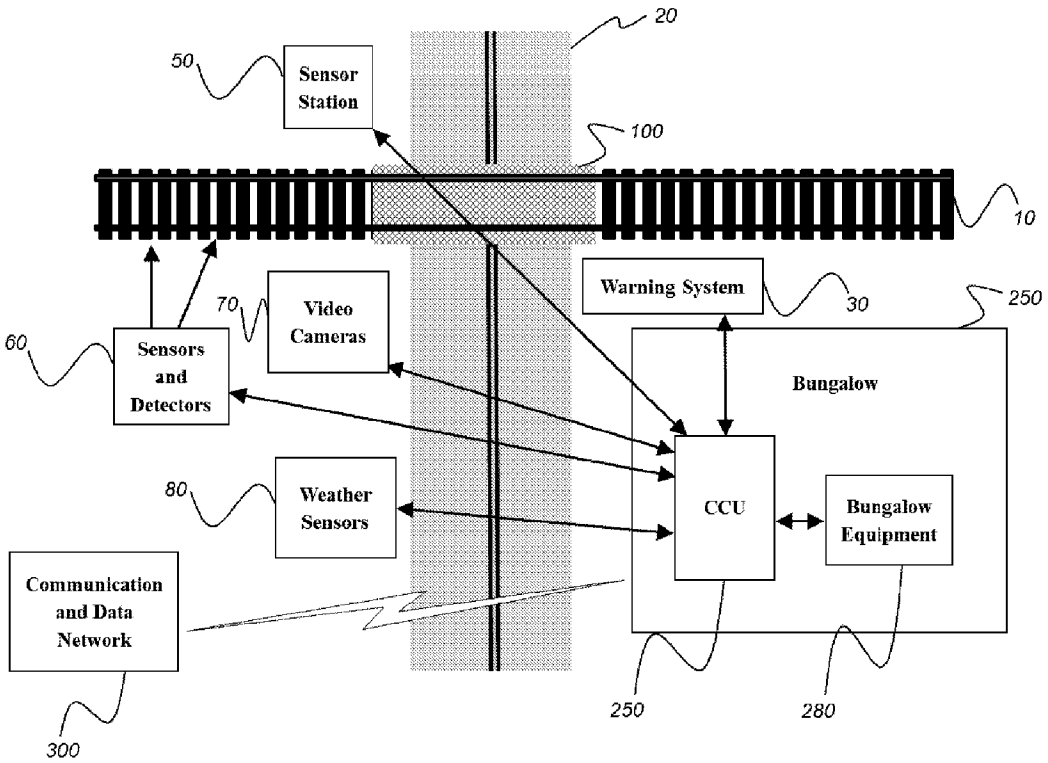
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CPC ***B61L 5/00*** (2013.01)
USPC **246/218**

(57) **ABSTRACT**

The present technology provides a rail crossing remote diagnostics system. The rail crossing remote diagnostics system includes a rail crossing station monitor installed in a bungalow at a rail crossing station. The station monitor has a communication module, such as a wireless transceiver, a connection to the ethernet, a cellular transceiver, a telephone connection, or a modem. The rail crossing remote diagnostics system also includes one or more diagnostic sensors installed at the rail crossing station. The diagnostic sensors are adapted to communicate with the station monitor. The station monitor automatically monitors at least one device installed at the rail crossing station and generates rail crossing diagnostics reports. The present technology also provides a rail crossing diagnostics network that includes a network hub and one or more rail crossing remote diagnostics systems. Certain embodiments also provide methods for automatically monitoring the operation of a rail crossing station.



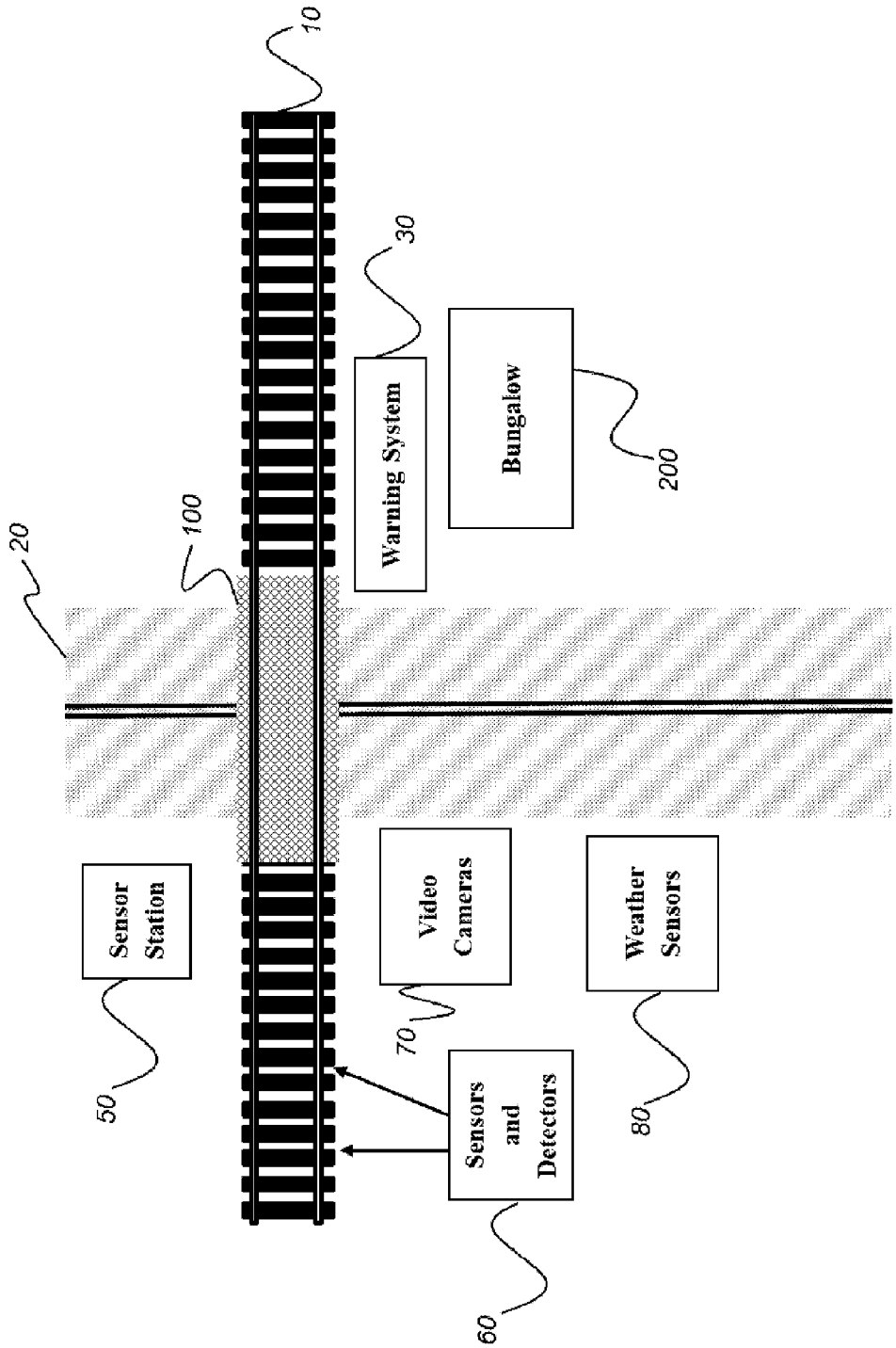

10
30
Warning System
Bungalow
200
20
100
Sensor Station
50
Video Cameras
70
Weather Sensors
80
Sensors and Detectors
60

FIGURE 1

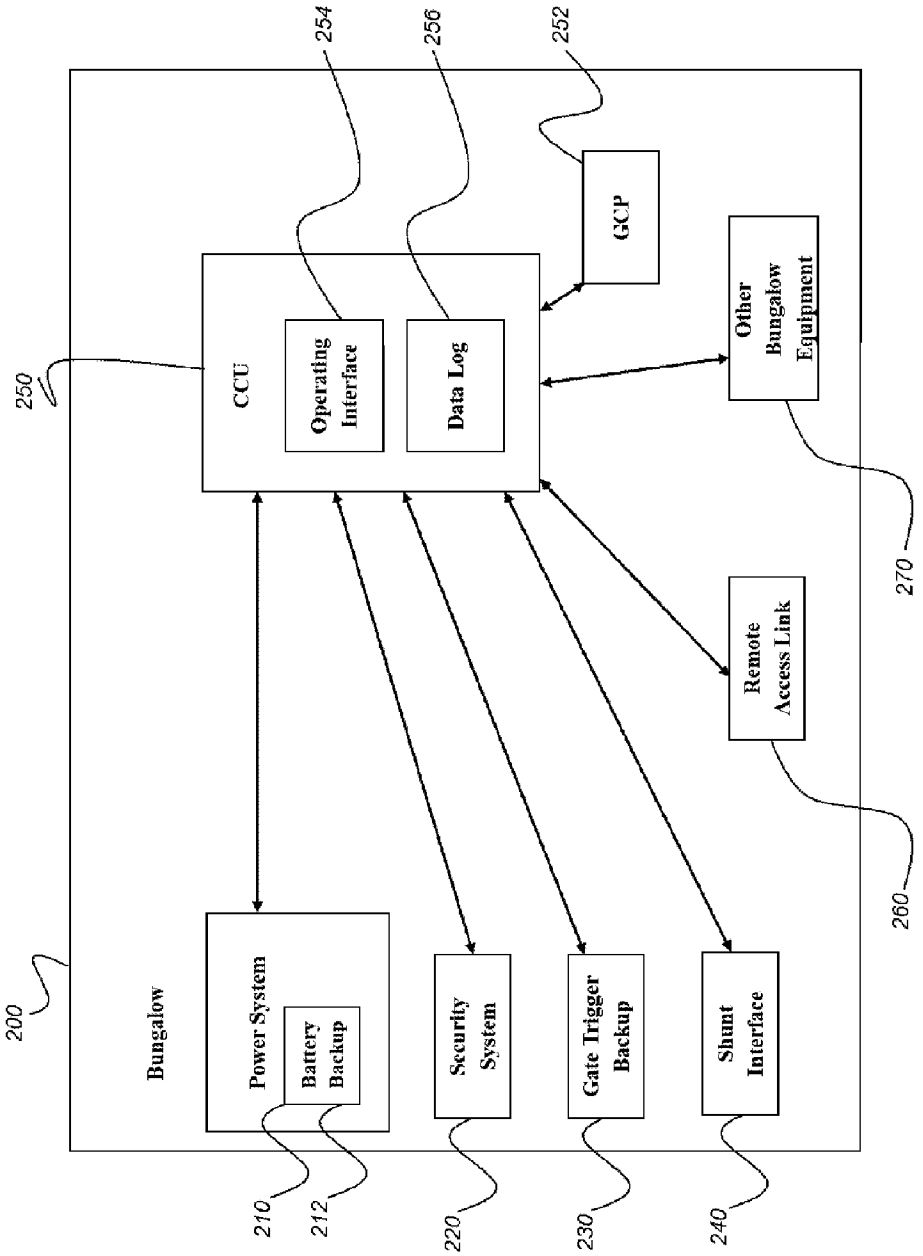

200
Bungalow
250
CCU
Operating Interface
Data Log
254
256
252
GCP
Other Bungalow Equipment
270
Remote Access Link
260
Power System
Battery Backup
210
212
Security System
220
Gate Trigger Backup
230
Shunt Interface
240

FIGURE 2

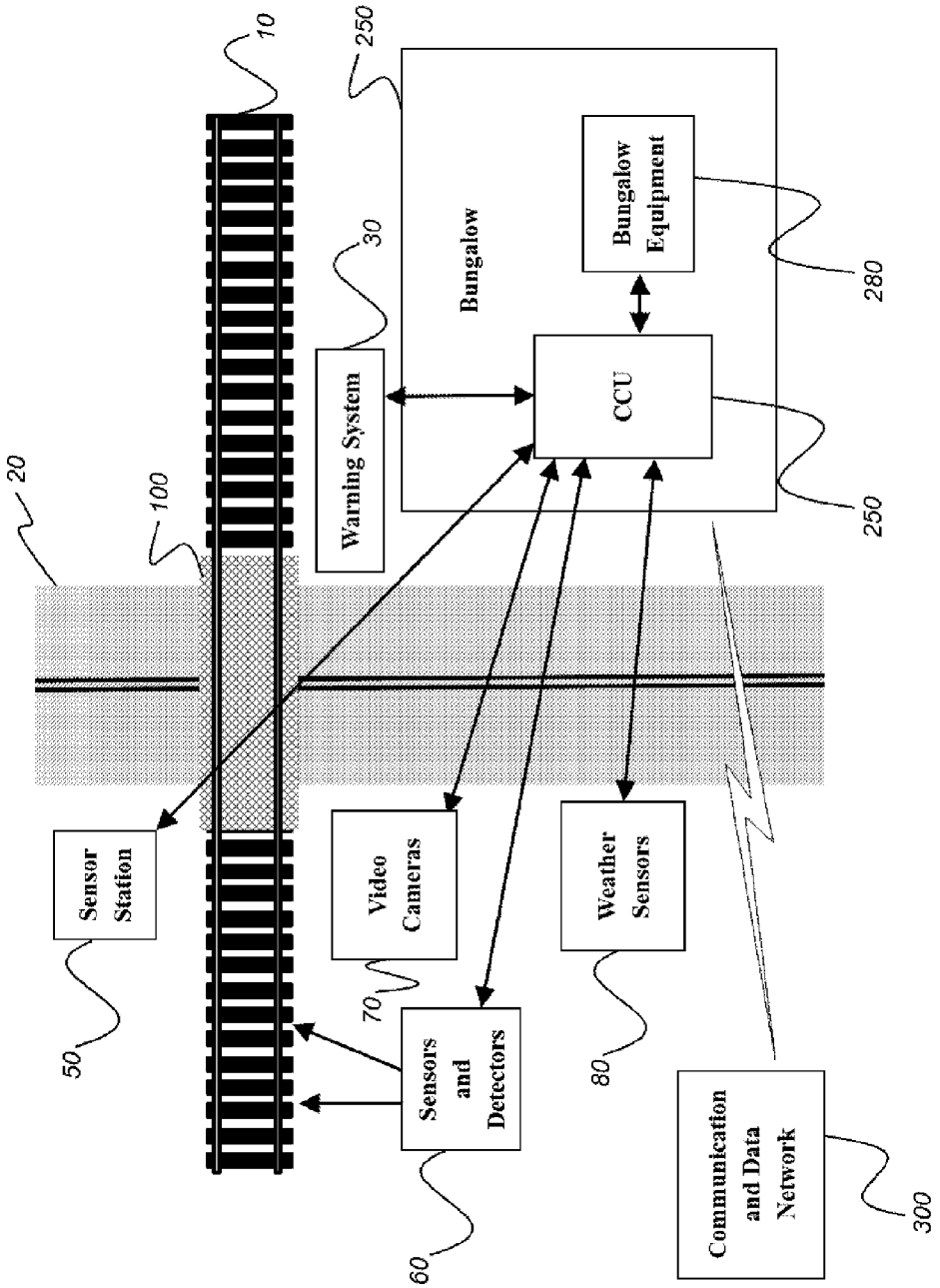

10
250
Bungalow
Bungalow Equipment
280
30
Warning System
CCU
250
20
100
Sensor Station
50
Video Cameras
70
Weather Sensors
80
Sensors and Detectors
60
Communication and Data Network
300

FIGURE 3

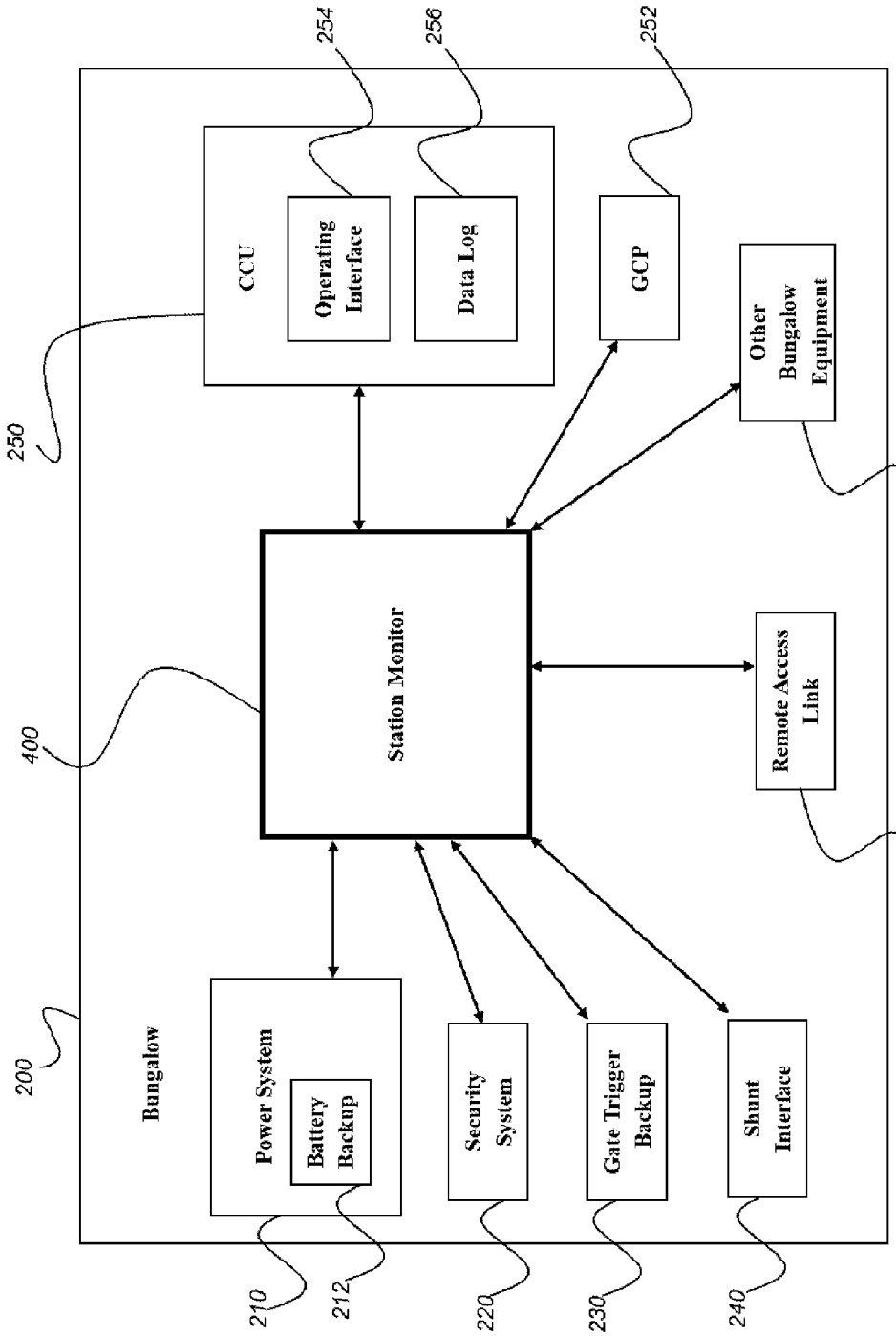

254
256
252
CCU
Operating Interface
Data Log
GCP
Other Bungalow Equipment
250
270
Station Monitor
400
Remote Access Link
260
Bungalow
200
Power System
Battery Backup
Security System
Gate Trigger Backup
Shunt Interface
210
212
220
230
240

FIGURE 4

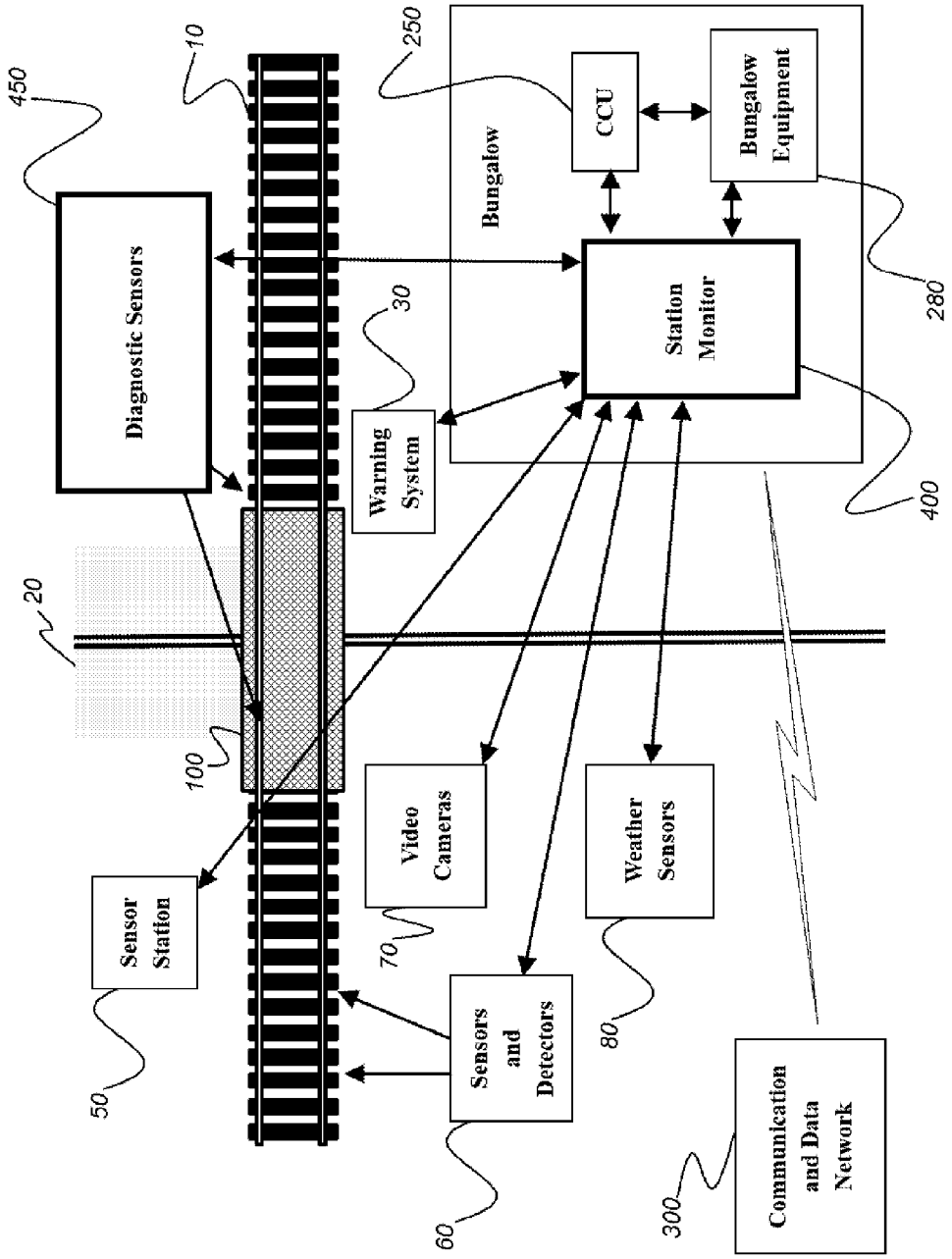

450
10
250
Bungalow
CCU
Bungalow Equipment
Diagnostic Sensors
Station Monitor
280
30
Warning System
400
20
100
Video Cameras
Weather Sensors
Sensor Station
70
80
50
Sensors and Detectors
60
300
Communication and Data Network

FIGURE 5

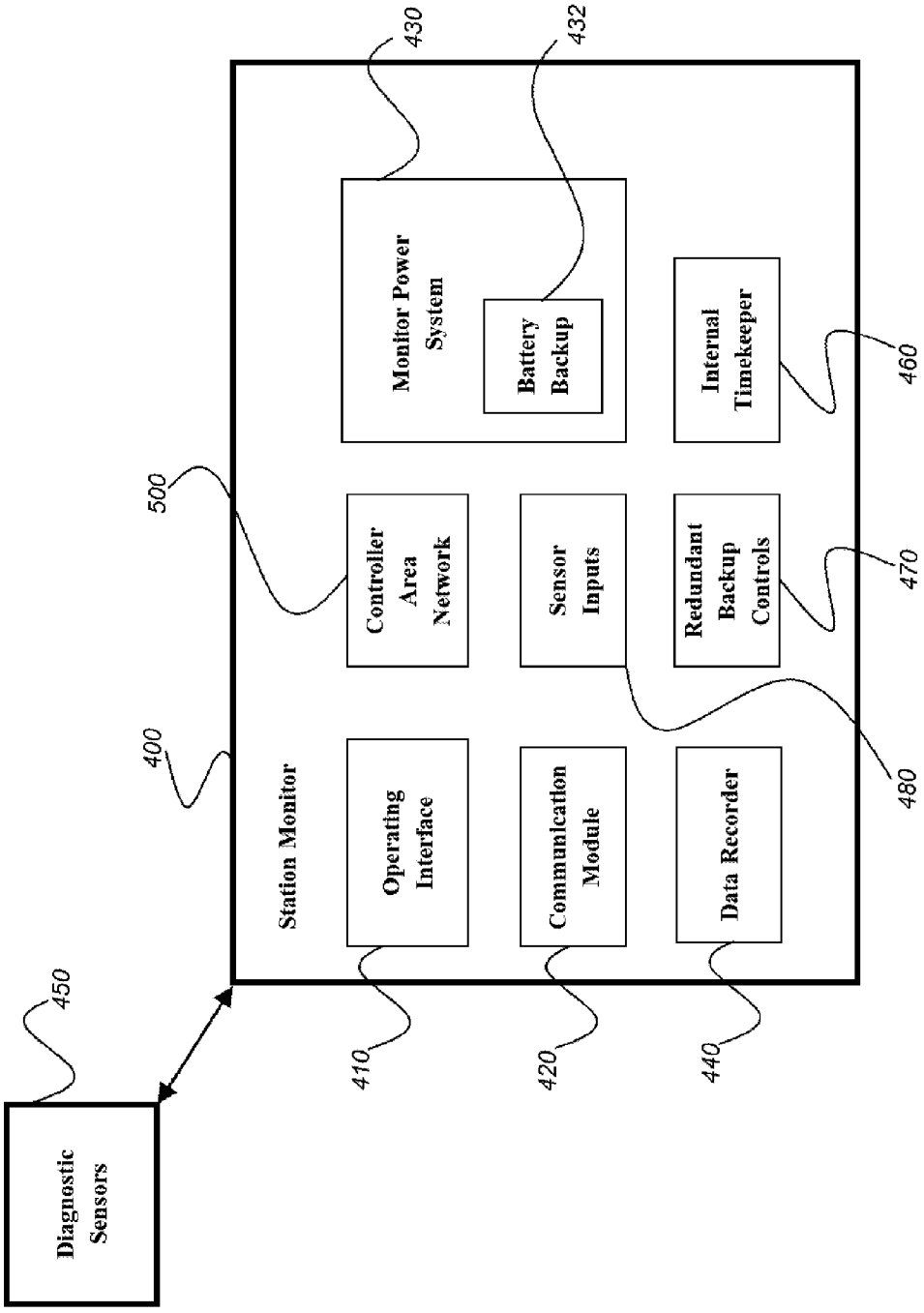

Diagnostic Sensors
450
Station Monitor
400
Operating Interface
410
Communication Module
420
Data Recorder
440
Controller Area Network
500
Sensor Inputs
480
Redundant Backup Controls
470
Monitor Power System
430
Battery Backup
432
Internal Timekeeper
460

FIGURE 6

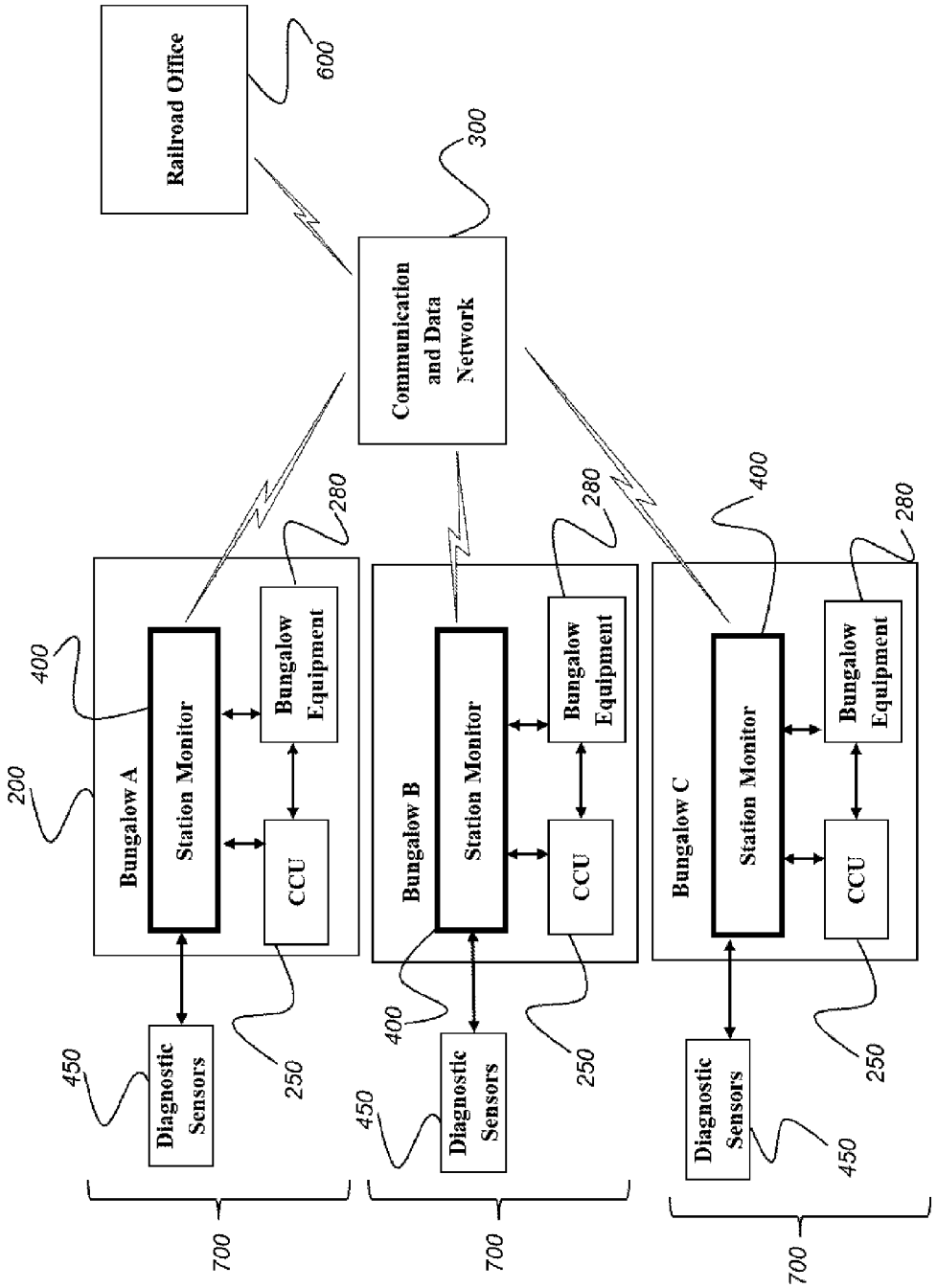

Railroad Office
600
300
Communication and Data Network
Bungalow A
Station Monitor
Bungalow Equipment
CCU
Diagnostic Sensors
Bungalow B
Station Monitor
Bungalow Equipment
CCU
Diagnostic Sensors
Bungalow C
Station Monitor
Bungalow Equipment
CCU
Diagnostic Sensors
200
400
450
250
280
700

FIGURE 7

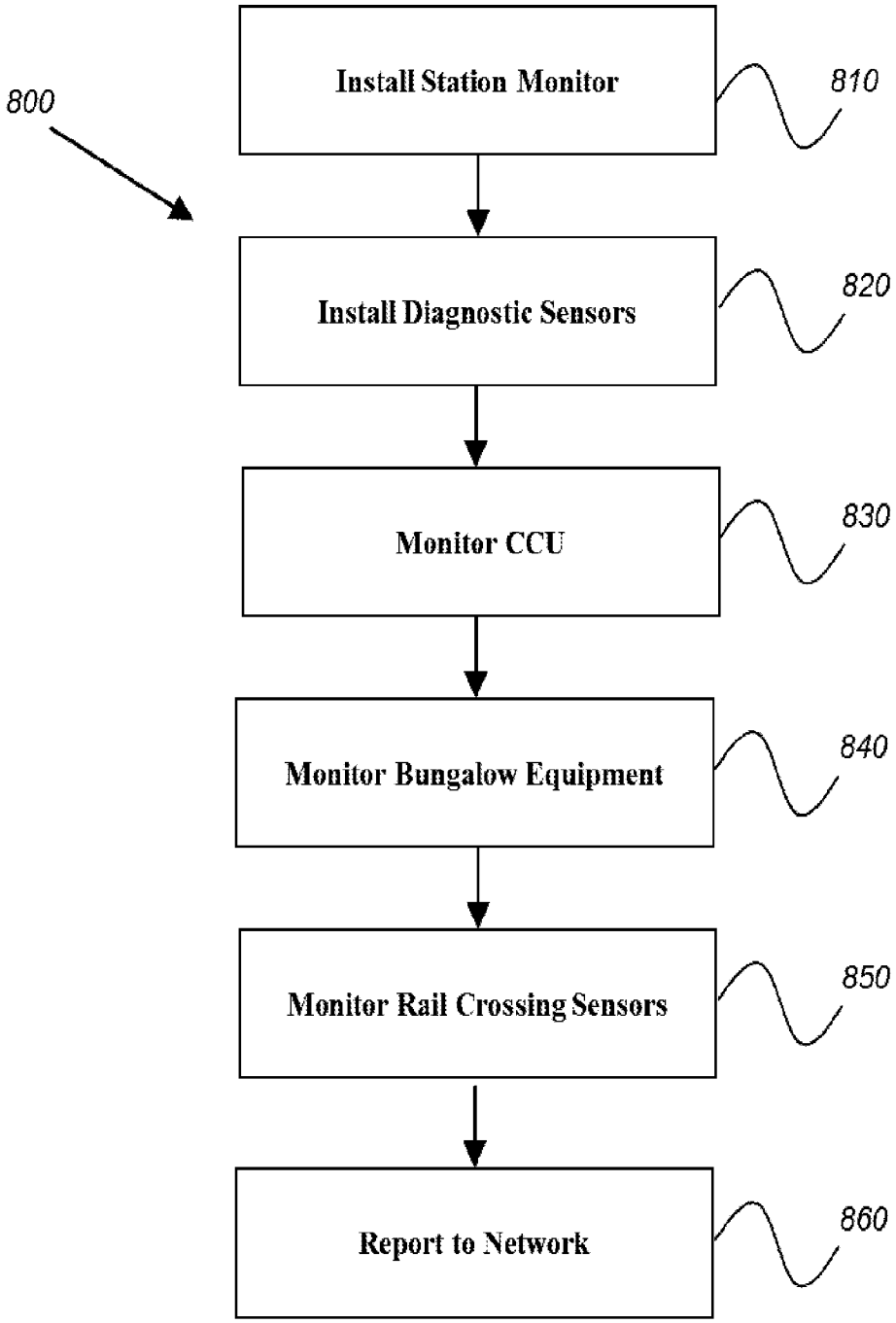

800
Install Station Monitor
810
Install Diagnostic Sensors
820
Monitor CCU
830
Monitor Bungalow Equipment
840
Monitor Rail Crossing Sensors
850
Report to Network
860

FIGURE 8

RAIL CROSSING REMOTE DIAGNOSTICS

RELATED APPLICATIONS

[0001] This application makes reference to, and claims priority to U.S. Provisional Patent Application No. 61/686,231 filed on Apr. 3, 2012 by Richard C. Carlson, titled "Rail Crossing Remote Diagnostics." U.S. Provisional Patent Application No. 61/686,231 is hereby incorporated by reference in its entirety.

BACKGROUND

[0002] Railroad companies are responsible for maintaining proper operation of the functions and features at rail crossing stations, i.e., locations where a section of rail intersects a section of road. These responsibilities include monitoring and ensuring proper the operation of rail crossing warning systems and related equipment. The rail crossing stations often include a warning system, which can include a warning light assembly, a gate assembly, and an audio warning, such as a bell, a horn or a siren, for example, and various sensors and/or detectors that trigger the warning system. The rail crossing stations also often include a bungalow or other enclosure that contains the control equipment, electronics and other hardware operating the functions of the rail crossing station.

[0003] To ensure safe operation of the rail crossing, it is important that the rail crossing warning systems are continually working properly. As a result, railroads typically have each rail crossing station manually inspected on a regular interval. For example, railroad companies may be required to send personnel to manually inspect each railroad crossing station at least once every 30 days. These inspectors manually inspect the equipment located at the rail crossing station including, for example, the sensors and detectors, the warning systems, and the equipment located in the bungalow, to ensure that the rail crossing station is operating in a safe and effective manner.

[0004] This manual inspection procedure can be a time consuming and expensive process, and it can also be prone to error. Moreover, if and when a manual inspection discovers a defect in the system, such a defect must be manually reported to the railroad, which may take a significant amount of time. This can result in an increase in the risk of accidents occurring as a result of an inoperative system while the defect is being reported. Additionally, because manual inspections cannot continually monitor the rail crossing stations, issues that may arise in between inspections can go undiscovered for several days or weeks.

SUMMARY

[0005] The present technology generally relates to rail crossing remote diagnostics ("RCRD") systems. In certain embodiments, the RCRD system can include a rail crossing station monitor installed in a bungalow at a rail crossing station. The station monitor has a communication module, such as a wireless transceiver, an ethernet or other internet connection, a cellular transceiver, a telephone connection, or a modem, for example. The RCRD system also includes one or more diagnostic sensors installed at the rail crossing station. The diagnostic sensors are adapted to communicate with the station monitor. For example, the diagnostic sensors may be wired to the station monitor, or connected to it wirelessly. The station monitor automatically monitors at least one device installed at the rail crossing station and generates rail crossing diagnostics reports.

[0006] The present technology also relates to rail crossing diagnostics networks ("RCDN"). The RCDN includes one or more RCRD systems installed at a rail crossing station. The RCRD systems include a station monitor with a communication module installed in a bungalow at the rail crossing station. The RCRD system also has one or more diagnostic sensors installed at the rail crossing station. The diagnostic sensors are adapted to communicate with the station monitor. The RCDN also includes a network hub that is in communication with the RCRD systems. The station monitor automatically monitors at least one device installed at the rail crossing station and generates rail crossing diagnostics reports. Further, the network hub allows for remote access to the at least one rail crossing station diagnostics system. In certain embodiments, the RCDN will include at least two rail crossing station diagnostics systems, and the network hub will provide remote access to each of the RCRD systems.

[0007] The present technology also provides methods for automatically monitoring the operation of a rail crossing station. The methods include monitoring equipment within a bungalow that has been installed at a rail crossing station using a station monitor that is installed in the bungalow. The operation of at least one rail crossing station sensor is also monitored using the station monitor and one or more diagnostic sensors installed at the rail crossing station, where the diagnostic sensors are in communication with the station monitor. The station monitor is used to generate a diagnostics report. Certain embodiments of the present technology may include the additional step of using the station monitor to transmit a diagnostics report over a network. Certain embodiments also include steps that execute station monitor functions or functionality based on remote commands received over a network. In certain embodiments, methods can also include the step of executing a backup control operation when the station monitor detects a problem at the rail crossing station.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIG. **1** depicts an example of a rail crossing station with various rail crossing station equipment.

[0009] FIG. **2** shows the relationship among internal components of a bungalow installed at a rail crossing station.

[0010] FIG. **3** shows the relationship among components of a bungalow and other equipment at a rail crossing station.

[0011] FIG. **4** is a modular diagram of a bungalow equipped with a station monitor.

[0012] FIG. **5** shows the relationship among a station monitor installed in a bungalow and other equipment at a rail crossing station.

[0013] FIG. **6** shows the relationship among components of a RCRD system that may be installed at a rail crossing station.

[0014] FIG. **7** shows a RCDN that includes multiple rail crossing diagnostics systems.

[0015] FIG. **8** is a flow diagram of a method for automatically monitoring the operation of a rail crossing station.

DETAILED DESCRIPTION

[0016] The presently described technology relates generally to systems and methods for monitoring rail equipment. More specifically, the present disclosure describes systems

and methods for automatically monitoring the equipment at a rail crossing station. Even more specifically, the present disclosure discloses systems and methods that automatically monitor the operation of a rail crossing controller unit and the related warning systems and sensors at a rail crossing station, and that can remotely communicate diagnostics reports over a network.

[0017] The presently described technology can reduce or alleviate the need for periodic manual inspections of rail crossing stations, or decrease the amount of work required by such manual inspections, because it employs a system of one or more remote sensors that automatically monitor many of the parameters that otherwise have to be inspected manually. Using the information obtained from this automatic monitoring process, the present technology system can identify predictive trends that allow for certain rail crossing station equipment to be replaced before they fail.

[0018] The present technology also allows for rail systems to connect and comply with new rail system standards, such as positive train control ("PTC"). That is, the present technology can provide automatic monitoring of crossing conditions and equipment functionality and operation in a manner that can be integrated within the PTC requirements framework.

[0019] FIG. **1** depicts an example of a rail crossing station that can utilize the presently described technology. For example, FIG. **1** depicts a rail crossing station that implements various sensors, detectors and other equipment that can be used in accordance with or as a part of the present technology. As shown in FIG. **1**, a rail track **10** intersects a road **20** at a rail crossing **100**. Because a rail crossing can be a dangerous intersection if traffic is not properly stopped on the road when a train is crossing, rail crossing stations often employ warning signals to notify oncoming vehicles when a train is arriving. This typically involves use of a warning system **30**, which can include warning lights and sounds, and a crossing gate that drops down to block the rail crossing in all intersecting directions. It is important that the warning signals generated by the warning system **30** are activated early enough before a train arrives to ensure that traffic is completely stopped when a crossing train arrives, but not so early that the warning system **30** unnecessarily obstructs traffic that could otherwise safely pass the crossing. For these and other reasons, rail crossing stations can employ a variety of sensors, detectors and other equipment to ensure that the warning signals are operating properly. The presently described technology provides systems and methods for monitoring these sensors, and also provides additional sensors and equipment to help ensure the safe operation of a rail crossing station.

[0020] As shown in FIG. **1**, a rail crossing station may employ a sensor station **50** that may include one or more sensors. For example, in certain embodiments of the present technology, sensor station **50** can include ambient light sensors, warning light sensors, gate tilt sensors, gate light sensors, gate integrity sensors, optical light sensors, current sense sensors, and accelerometer/tilt sensors, for example. These sensors can be used to ensure that the lights of the warning signals are visible, that warning signal noises are audible, that the gate is lowering and/or tilting to the proper angle, and that the gate is still in tact, for example. The rail crossing station can also include sensors and detectors **60** that are built into or placed on the rail track **10** itself. For example, the sensors and detectors **60** may include wheel detectors that detect the presence of a train wheel on the track, equipment temperature sensing equipment, a dragging equipment detector that detects when a passing train is dragging equipment along the track, a shunt system or other sensors that detect the location and/or velocity of an oncoming train, sensors that monitor the time it takes a train to pass over the crossing station, and sensors that monitor the time it takes from the gate to lower until the train arrives at the crossing.

[0021] Additionally, certain embodiments of the present technology may provide, or operate with a crossing station that incorporates one or more video cameras **70** that record video footage of the rail crossing station. The video cameras **70** can record the rail crossing warning system **30** to ensure that the gates and lights are operating properly when a train is crossing, for example. The video cameras **70** can also be used to ensure that all of the lights along the gate are operating properly, or to determine whether one of the lights may have burned out.

[0022] A train crossing station can also include weather sensors **80** that record and monitor various weather conditions such as the temperature, precipitation levels, and wind speed, for example. Information about the weather conditions from the weather sensors **80** can be used to anticipate potential problems with the crossing warning system **30** (e.g., it may anticipate that ice buildup may cause issues with the gate), or to control the timing of the warning systems **30** itself (e.g., the warning system **30** may be activated earlier when the weather sensors **80** detect that the roads may be wet or slippery), for example.

[0023] FIG. **1** also depicts a bungalow **200**, which can be a housing, a box structure, or another enclosure that houses equipment used at the rail crossing station. The bungalow **200** houses the controlling equipment for the rail crossing station. As shown in FIG. **2**, the bungalow can house a crossing controller unit **250** ("CCU") that controls the operations of the rail crossing station. The CCU can control the function of the gate or the warning lights of the crossing warning system **30**. The CCU **250** can include an operating interface **254** that allows a user to access and control the CCU and the related functions that it controls. The CCU **250** may also comprise a data log **256** that obtains and makes records of rail crossing events. For example, the data log **256** may keep a record of the time that a warning gate is lowered, the time that the train crosses the station, or any problems that may have occurred with the with the crossing warning system **30**. Typically, a manual inspector can obtain information stored in the data log **256** by using the operating interface **254**.

[0024] The CCU **250** may also operate in connection with a grade crossing predictor **252**. The grade crossing predictor ("GCP") **252** can be connected to sensors or detectors on the rail track, and can notify the CCU when to turn on the warning signals. For example, using sensors and detectors on the train track itself, the GCP **252** may detect the location and/or velocity of an oncoming train. When the GCP **252** predicts that the oncoming train will be passing the crossing in a predetermined amount of time, the GCP **252** may notify the CCU **250** to execute the crossing warning signals.

[0025] The bungalow may also include a power system **210**, which can be an alternating current power source, for example. The power system **210** may also include a backup battery **212** that allows the CCU to continue operating in the event of a power outage. The backup battery **212** can maintain a full charge from the power system **210**, so that the backup battery **212** is maximized with full power in the event that a backup power source is needed.

[0026] The bungalow may also include a variety of other equipment. For example, the bungalow may include a security system **220** that inhibits intruders from breaking into the bungalow **200** to steal the equipment or otherwise manipulate the rail crossing station.

[0027] The bungalow **200** may also include a gate trigger backup control **230**. The gate trigger backup **230** can be used to operate the crossing gate in the event that the CCU **250** is unable to operate the crossing gate. For example, the gate trigger backup **230** may be a mechanical override that sets the gate to the default "down" position in the event that the CCU **250** is having difficulty operating the gate.

[0028] The bungalow may also include a shunt interface **240**, which monitors the signal integrity of the gate trigger system. For example, a shunt system uses the rail tracks as a circuit, and continually monitors the voltage and current across the circuit to determine the location and/or approaching speed of a train. The shunt interface **240** operates with the CCU **240** to properly operate the various functions of the rail crossing station based on the detected presence and/or velocity of an oncoming train.

[0029] In certain embodiments of the present technology, the bungalow **200** can include a remote access link **260**. The remote access link **260** allows the CCU **250** and other bungalow equipment to communicate remotely with a network. The remote access link **260** may include antennae or other hardware and equipment that allow the CCU **250** to communicate external to the bungalow **200**. In this manner, a user can remotely access the CCU and other equipment to ensure its safe and proper operation, and make adjustments or operational modifications if desired. The bungalow may also include other bungalow equipment **270**, such as clock or timer, an input device such as a keyboard or keypad, lights, and additional sensor input connections, for example.

[0030] The bungalow **200** is connected, either via a wire connection or a wireless connection to the various sensors, detectors and equipment located at or around the rail crossing station. FIG. **3** demonstrates the connection between the bungalow and various equipment located at or around a rail crossing station. As depicted, the CCU **250** can communicate with the warning system **30**, the sensor station **50**, the various rail sensors and detectors **60**, the video cameras **70** and the weather sensors **80**. The CCU can also be connected to a communication and data network **300** via a remote connection, for example, via the internet, via a cellular connection, or by another connection. The CCU **250** is also connected to other bungalow equipment **280** within the bungalow **200**, which can include, for example, the equipment depicted in FIG. **2**. In this manner, the CCU **250** can obtain and record all necessary information from the sensors both internal and external to the bungalow **200**, and use the information to operate the rail crossing warning system **30** and other functionality. The CCU **250** can also generate data reports and other information that can be transmitted to the communication and data network **300**. Additionally and/or alternatively, the data reports can be viewed manually by an inspector at the bungalow **200**, for example, via the CCU operating interface **254**.

[0031] FIG. **4** depicts one embodiment of a bungalow **200** employing an RCRD system of the present technology. As shown in FIG. **4**, the bungalow **200** includes a CCU **250** and the other equipment depicted in the bungalow **200** of FIG. **2**. FIG. **4** also includes a station monitor **400** that interacts with the CCU and the other bungalow equipment. The station monitor **400** can be a sensor communication hub and/or another controller unit. The station monitor **400** can monitor the function of the equipment at the rail crossing station, perform diagnostics on the rail crossing station equipment, and can serve as a backup control source for the rail crossing station. In certain embodiments, the station monitor **400** can automatically perform many or all of the functions that are typically provided by a manual inspector.

[0032] FIG. **5** depicts another embodiment of a rail crossing station that shows the relationship among a station monitor **400** and other equipment at a rail crossing station. As shown, the station monitor **400** interacts with the rail crossing station equipment, including the warning system **30**, the sensor station **50**, the rail track sensors and detectors **60**, the video cameras **70**, and the weather sensors **80**, for example. The station monitor **400** is also in communication with a communication and data network **300**. In this manner the station monitor **400** can generate diagnostics reports and transmit the reports and other information to a remote user through the communication and data network **300**. That is, the station monitor **400** can promptly notify a railroad company main office through the communication and data network **300** when a problem is detected. For example, the station monitor may transmit a diagnostics report or otherwise generate a signal through the communication and data network **300** when the station monitor recognizes that the crossing station warning system **30** is not operating in the most effective manner.

[0033] FIG. **5** also depicts diagnostic sensors **450** located at or around the rail track **10** on or near the rail crossing **100**. In certain embodiments, the diagnostic sensors **450** can serve as backup sensors to those already in place at the rail station. For example, the diagnostic sensors **450** can serve the same or similar functions to the sensors located in the sensor station, the rail track sensors and detectors **60**, the video cameras **70** or the weather sensors **80**. In this manner the station monitor **400** and the diagnostic sensors **450** can operate together to monitor the operation of at least one sensor installed at the rail crossing station. That is, the diagnostic sensors **450** may communicate information to the station monitor **450** that can be compared with the information transmitted to the CCU **250** to operate and control the rail station. The station monitor **400** can compare the information from the diagnostic sensors **450** with the CCU **250** information to ensure that the rail crossing station equipment is operating effectively, accurately and/or efficiently. For example, the RCRD of the present technology may employ a diagnostic sensor **450** at or around the wheel track that uses a shunt operation to monitor the location and/or velocity of an approaching or present train. This information can be communicated to the station monitor **450** and compared with the information used by the CCU **250** to determine when to execute the rail crossing warning system **30**. In other words, if the information obtained from the diagnostic sensors **450** differs significantly from the information used by the CCU **250**, the monitor may recognize a problem with at least one of the rail station crossing equipment or the CCU **250**, and generate a diagnostics report or other signal accordingly. And using the communication and data network **300**, the RCRD of the present technology can promptly notify railroad personnel of the problem.

[0034] In certain embodiments, the diagnostic sensors **450** can be installed external to the bungalow **200** as shown in FIG. **5**. Additionally and/or alternatively, the diagnostic sen-

sors **450** can also be installed inside of the bungalow **200**. For example, the diagnostic sensors **450** can include a wheel sensor, a gate tip sensor, a dragging equipment sensor, a wind speed monitor, an equipment temperature sensor, a video camera sensor, an ambient light sensor, a light signal sensor, a backup gate sensor, a sound sensor, a power source sensor, a timing sensor, a shunt sensor, a shunt interface sensor, a communication module sensor, and/or a security system sensor. The diagnostic sensors **450** and the station monitor **400** can operate together to create an RCRD that monitors the performance of various crossing station functionality. For example, the RCRD can monitor the performance of signal roundel lights, gate lights, gate tilt, gate integrity, time between the gate lowering and train arrival, time the train is in the crossing area, power integrity into the bungalow, power level of bungalow backup battery, bungalow date and time, signal integrity of gate trigger system, and the status of backup gate activation systems. The RCRD can relay information obtained from monitoring these features to a user via the communication and data network **300**. Certain embodiments of the present technology may employ diagnostic sensors **450** installed both external to the bungalow **200**, and internal to the bungalow **200**.

[0035] As shown in FIG. **5**, the station monitor **400** also continues to interact with the CCU **250** and other bungalow equipment **280** located inside the bungalow **200**. For example, the station monitor may automatically monitor the power level of the backup battery **212** of the power station **210** within the bungalow **200**. Similarly, the station monitor can automatically monitor the proper operation of the security system **220**, the gate trigger backup **230**, the shunt interface **250**, the remote access link **260**, or other bungalow equipment **270**, for example.

[0036] The station monitor **400** can also monitor the accuracy of the CCU **250** reporting information. For example, using the diagnostics sensors **450**, the station monitor may generate its own data reports. The monitor may also compare its data reports with the data reports stored in the data log **256** of the CCU **250**. If the station monitor recognizes significant differences between the information in the CCU **250** data log **256**, and the information recorded and generated by the station monitor **400** itself, the station monitor **400** may generate a diagnostics report or signal to transmit over the communication and data network **300**. Alternatively and/or additionally, the station monitor **400** may take action to correct the issues. For example, if the station monitor **400** recognizes that certain events recorded in the station monitor data log correspond to events recorded in the CCU **250** data log, but those events are marked as occurring at different times, the station monitor **400** may take steps to coordinate the internal clock of the CCU **250** with an appropriate time.

[0037] FIG. **6** depicts a diagram of the station monitor **400** and its interaction with the diagnostic sensors **450**. As shown, the station monitor **400** may comprise a number of components, modules, programs or other equipment. For example, the station monitor **400** may include an operating interface **410** that allows a user to interact with and otherwise operate functionality of the station monitor **400**. The operating interface **410** may include a keyboard and a monitor, or a touchscreen interface, for example. Additionally and/or alternatively, the operating interface **410** of the station monitor may be accessed remotely via the internet. In this manner a user can log into the station monitor through the communication and data network **300** to read diagnostics reports and execute station monitor functionality.

[0038] In certain embodiments of the present technology, the station manager **400** also includes a communication module **420** that allows it to interact with the communication and data network **300**. The communication module **420** can be a cellular device, a modem, an ethernet or internet hub, a wireless communication device, or a telephone, for example. Via the communication module **420**, a user can remotely access the station manager **400** via a communication and data network **300** and obtain information or execute station monitor **400** functionality.

[0039] The station monitor also includes its own monitor power system **430**. The monitor power system **430** can be an alternating current power source that is connected to the grid. The monitor power system **430** can also include a battery backup **432** that can continue to operate the station monitor and/or all the equipment in the bungalow **200** in the event of a power outage. For example, the station monitor battery backup **432** may serve to keep the CCU **250** and other bungalow equipment **280** operating during a power outage after the bungalow power source backup battery **212** has been depleted.

[0040] The station monitor may also include a data recorder **440** that maintains a data log, for example. As noted above, the station monitor **400** may use the data recorder **440** to generate diagnostic reports or to compare with the data recorded by the CCU **250**, for example. The station monitor **400** can transmit data and other information recorded by the data recorder **440** over the communication and data network **300** via the communication module **420**, for example. In certain embodiments, the data recorder **440** can record the events of the CCU **250** on a recording loop over a period of time (e.g., several hours). The data recorder **440** can be controlled by an interface, and may even require a security feature before the data maintained by the data recorder **440** can be accessed.

[0041] In certain embodiments, the station monitor may include one or more redundant backup controls **470**. The redundant backup control **470** can operate at least one rail crossing station function when the station monitor detects a problem at the rail crossing station. For example, the station monitor **400** can execute the redundant backup controls if and when the CCU **250** or other crossing station equipment is not operating as designed. Where the station monitor recognizes that the crossing gate is not lowering a sufficient amount of time before the arrival of an oncoming train (e.g., because of a problem with the CCU shunt interface **240**), then the station monitor **400** may execute one or more redundant backup controls **470** to override the CCU **250** gate control, or to resort to a default "gate down" setting. In this manner the station monitor can assist the crossing station to default to a fail-safe mode.

[0042] The station monitor **400** may also include an internal timekeeper **460**, which can be a clock or other device that maintains time independent from that maintained by the CCU **250** or other equipment in the bungalow or at the crossing station. In certain embodiments, the internal timekeeper **460** may receive an atomic clock signal to continually ensure that the station monitor internal time is relatively accurate. Using the internal timekeeper **460**, the station monitor can ensure

that the CCU **250** is also maintaining an accurate time, and can take steps to adjust the CCU **250** internal time when necessary.

[0043] The station monitor **400** can also comprise a series of sensor inputs **480**. These sensor inputs can be, for example, a sensor communication hub that allows the station monitor to connect to the CCU **250** and/or one or more of the station sensors, including the diagnostic sensors **450** installed as a part of the RCRD. By including additional sensor inputs **480**, the station monitor **400** allows room to monitor additional sensors and crossing equipment that may be installed at the crossing station after the station monitor is installed into the bungalow **200**, for example.

[0044] The station monitor **400** can also comprise or operate in connection with a controller area network ("CAN") **500**. The CAN **500** allows the station monitor **400** to interface and connect with the CCU **250**. For example, the CCU **250** may either contain all of the interface connections required for the individual sensors or may be constructed such that the sensor interfaces stack or nest with the CCU **250**. In this manner, the connections between the components can use a common bus structure like the CAN **500** so that any number of sensor nodes may be connected to the CCU **250**, the station monitor **400**, or both, for example.

[0045] The station monitor **400** may also include additional equipment not depicted in FIG. **6**. For example, the station monitor **400** may include a bungalow intrusion alarm that operates independently from any security system of the bungalow **200**. Further, the station monitor **400** may also include one or more video cameras that record video footage within the bungalow. In this manner, a user may remotely operate the station monitor **400** to view the inside of the bungalow to view certain visual signals or readings. For example, a user can access a video camera of a station monitor **400** to obtain a remote visual reading of a power meter connected to the bungalow power source **210**, or to view various lighting signals that may be installed inside of the bungalow.

[0046] FIG. **7** shows a network, i.e., an RCDN that includes multiple rail crossing diagnostics systems. For example, an RCDN may include more than one RCRD such that each RCRD on the network can be accessed via the communication and data network **300**. FIG. **7** depicts three separate RCRD's connected to the communication and data network **300**, but it should be understood that the RCDN of the present technology is not limited to a particular number of RCRD's. For example, in certain embodiments, the RCDN can include all of the RCDN's installed at all of the rail crossings along a particular railroad. In this manner, a railroad office **600** can access, interface and operate the various station monitors **400** and CCU's at each crossing station in the network via the communication and data network **300**. Alternatively, in certain embodiments, an RCDN may include as few as one RCRD.

[0047] As shown in FIG. **7**, each RCRD **700** includes a bungalow **200** which is installed at a rail crossing station. The bungalow **200** comprises a station monitor **400**, a CCU **250** and bungalow equipment **280**, which can include, for example, the bungalow equipment described with respect to FIGS. **2-5**. Each RCRD **700** also includes at least one diagnostic sensor **450**, which is used in connection with the station monitor **400** to monitor the safe and functional operation of the sensors, detectors and other equipment at a rail crossing station. Each RCRD **700** is remotely connected to the communication data network **300**. The RCRD's **700** may be connected to the communication and data network **300**, for example, through the internet or via a cellular communication, which can be facilitated by a communication module or a remote access link located in the individual station monitors **400** or bungalows **200**. Through the communication and data network **300**, a user can log in and access each RCRD **700** to obtain station monitor **400** readings, CCU **250** readings, or diagnostic reports, for example. In certain embodiments, the users may also be able to log in to execute certain controls or functionality. For example, in certain embodiments, a station monitor at one RCRD **700** on the RCDN may recognize that the sensors at the crossing station are faulty, and generate a signal to the railroad office **600** via the communication and data network **300**. A user a user at the railroad office **600** can then log into the network and access the station monitor **400** and/or the CCU **250** at that particular crossing station, and correct the problem, or execute functionality (e.g., trigger a default fail-safe mode) without having to send personnel out to the crossing station directly.

[0048] In operation, the present technology provides for automatic monitoring of the systems, sensors, detectors and other rail crossing station equipment, and their performances. For example, the RCRD of the present technology is capable of automatically monitoring at least the following rail crossing station equipment: signal roundel lights, crossing gate lights, crossing gate tilt, crossing gate integrity, the time between the gate lowering and train arrival, the time a train is in the crossing area, the power integrity going into control bungalow, the signal integrity of the crossing gate trigger system (i.e., shunt), the power level of backup battery power in the bungalow, the status of any backup crossing gate activation systems, the status of any bungalow intrusion alarms, additional sensor inputs for alternate bungalow configurations, video cameras that record crossing activity, and/or a CCU data recorder that records data on a storage medium.

[0049] The information and data obtained by the RCRD of the present technology can be remotely accessed through one or more communication technologies, such as cellular modems, remote radio links, ethernet connections or a hard wired link.

[0050] As the RCRD gathers information, it can collect and display the information in a custom database that provides input into the rail crossing station operation status. For example, the database can provide an overall view of the control bungalow operation with options to open specific detailed sensor nodes so that a user can check on an individual sensor performance. The RCRD can also log and display trends that can provide for accurate and beneficial predictions. For example, the RCRD can detect trends that may be able to predict when certain sensors or equipment will fail using performance degradation techniques. Based on these predictions, the RCRD may be able to provide predictive notifications in advance of actual failures.

[0051] The RCRD of the present technology can also utilize and a plurality of sensing technologies. These sensing technologies can include, for example a combination of electrical current sensors, optical sensors, and ambient light sensors that can be combined and compared to monitor proper operation of lighting equipment. Moreover, the RCRD can also utilize gate lowering and integrity sensors including, for example, a wired or wireless system with an accelerometer and/or a tilt sensor that reports when the gate is in its level position. Such sensors can also recognize and report when the

gate is tipped on an unnatural axis signifying that the gate has been dislodged from its normal operating position.

[0052] Additionally, the RCRD of the present technology can also automatically monitor the crossing station's ability to measure the time between gate lowering and train arrival, the time that a train takes to pass the crossing station, or the time that the train remains on the island of a crossing station. These measurements can be checked by either monitoring existing signals present in the control hardware (e.g., the CCU), or by supplementing the measurements by installing additional rail-based sensors that detect the presence of the train.

[0053] The RCRD of the present technology can also automatically monitor bungalow power levels by connecting to existing power lines in either the bungalow primary and/or backup power systems. The present technology can also include a separate battery backup system as a part of the RCRD.

[0054] The RCRD of the present technology can also provide ways to monitor signal integrity of gate trigger system, or the shunt. In this manner, the present technology can automatically monitor multiple items that otherwise require manual inspection. For example, the present technology can monitor the rail crossing signal strength to ensure that the signal strength is near 100% when the track is empty, i.e., when no train is approaching. The present technology can also monitor the rail crossing signal strength to ensure that it properly reduces down from 100% as an oncoming train approaches. In certain embodiments, the present technology can also monitor the shunt phase as an indicator of the integrity of the gate trigger system.

[0055] Certain embodiments of the present technology can automatically monitor existing (or previously installed) bungalow intrusion alarms using either an existing alarm system, or by using a separately installed system, such as a motion detector system, for example.

[0056] The present technology may also implement alternate sensor inputs that can be used to monitor external sensors such as detection systems, wind speed monitors, dragging equipment sensors, equipment temperature measuring devices or other rail measuring devices, for example.

[0057] The RCRD of the present technology can also automatically monitor a variety of rail crossing station events that otherwise require manual inspection. For example, the RCRD can be configured to monitor the amount of time that a train takes to cross a rail crossing station. Trains that take longer than a predetermined period of time, (e.g., 10 minutes or longer) can result in fines issued by local traffic authorities. The present technology can remotely determine whether any train crossing stations are experiencing or have experienced trains that take more than a predetermined period of time to pass through the crossing by monitoring the output from the CCU. The RCRD can then report this issue to the railroad and/or the proper authorities so that the issues can be addressed accordingly.

[0058] The RCRD can also monitor whether crossing gates are appropriately lowering within a predetermined amount of time before the arrival of a train. For example, the FRA may require that crossing gates should be lowered at least 20 seconds before the train arrives. In certain embodiments of the present technology, the RCRD can automatically monitor the crossing gate lead time at a crossing station by comparing the CCU output against a track sensor. The RCRD can report this information to the railroad, to the FRA, or to other parties that may have an interest in this information.

[0059] Certain embodiments of the present technology can also automatically monitor whether a crossing gate is stuck in a certain position. In particular, the present technology can monitor whether a crossing gate is stuck in the up position, and not capable of being automatically lowered. Without automatic monitoring of this feature, such an issue may only be noticeable when a train is approaching, which can create a dangerous situation resulting in high risk of accidents. Using the present technology, such a gate-stuck-up issue can be detected before a train ever approaches the crossing station by comparing the CCU output against a gate tip sensor. Any issues can thereby be reported to the railroad over a network and addressed before a train crosses the crossing station. Similarly, the RCRD of the present technology can monitor a gate-stuck-down feature, by comparing CCU output against gate tip sensor readings, for example. Moreover, the present technology can also monitor whether the gate is damaged using the output of a sensor

[0060] The RCRD of the present technology can also automatically monitor whether the crossing station or bungalow main (AC) power is out or not working using a line power feed into the station monitor. The RCRD can also detect when the backup battery or batteries are low. For example, many backup batteries are lead-acid batteries that have established patterns of battery voltage and temperature that can allow for the current state of the battery charge level to be predicted or determined. Moreover, certain railroads may utilize a bank of single cells that are chained together. In such an embodiment, the RCRD could be employed to detect and/or identify a single bad cell without requiring individual probes into each cell. In certain embodiments, the RCRD can monitor the battery banks to ensure that two or more separate banks of batteries with different charges are properly isolated.

[0061] The present technology can also be used to detect if and when lights have burned out, turned off, or are otherwise not visible. For example, for traditional incandescent bulbs, this can be accomplished by monitoring the electrical continuity across the filament of the bulbs. However, this technique may not work where the lights being checked are LED lights, or where the lights are not visible because they are dirty, or covered with mud. In such a situation, the present technology may use one or more light sensors or video cameras to monitor whether the lights at a crossing station (e.g., the lights along a crossing gate) to are operating properly.

[0062] The RCRD of the present technology can also automatically monitor a smart bell operation of a crossing station. For example, certain train crossing stations employ a speaker or a bell that may be mounted to the railroad crossing sign, for example, to duplicate the sound of a train horn or bell so the actual train does not have to blow its horn. The present technology can automatically monitor the operation of such a smart bell, for example, by using a microphone in connection with the station monitor.

[0063] The present technology can also be used to obtain and reference crossing logs from a crossing station. For example, crossing stations CCU's may have a recorder interface module that logs and/or records when various signals have changed. These logs often provide a time stamped history of events, such as when a train was detected and when gate was lowered, for example. The present technology can ensure that the time stamps on these logs is accurate by automatically monitoring the internal clock of the CCU.

Additionally and/or alternatively, the station monitor of the present technology can maintain its own data log as a backup, or a secondary comprehensive log.

[0064] The present technology can also automatically monitor grounding issues at a crossing station. For example, a railroad may experience difficulties when a current surge flowing into a ground connection temporarily causes the ground voltage to move away from zero, because this can cause intermittent faults in the crossing station circuitry. The RCRD of the present technology could automatically monitor the ground voltage level, for example, by wiring the ground connection into a voltage sensor and monitoring the voltage at the ground. If and when this ground voltage level fluctuates away from zero, the RCRD can generate a notification, or take preventative steps as necessary.

[0065] In certain embodiments of the present technology, the RCRD may monitor the proper operation of crossing station redundant circuit boards. For example, a typical crossing predictor system typically has two banks of circuit boards, a primary and a backup. The present technology can monitor whether any of the circuit boards have faulted, and cause the system to switch over to the unused bank if necessary.

[0066] Certain embodiments of the present technology also present methods for automatically monitoring the operation of a rail crossing station. FIG. **8** is a flow diagram of a method **800** for automatically monitoring the operation of a rail crossing station. In certain embodiments, at step **810**, the method includes installation of a station monitor at a rail crossing station. For example, the station monitor can be installed at a bungalow and connected to a CCU and/or other crossing station equipment.

[0067] At step **820**, diagnostic sensors are installed. The diagnostic sensors can be installed external to the bungalow, for example, on or around the train track, and on or near the crossing station. For example, the diagnostic sensors can include a wheel sensor, a gate tip sensor, a dragging equipment sensor, a wind speed monitor, an equipment temperature sensor, a video camera sensor, an ambient light sensor, a light signal sensor, a backup gate sensor, a sound sensor, a power source sensor, a timing sensor, a shunt sensor, a shunt interface sensor, a communication module sensor, and/or a security system sensor. The diagnostic sensors and the station monitor can operate together to create an RCRD that monitors the performance of various crossing station functionality.

[0068] At step **830**, the operation of the crossing station CCU is monitored. This can be done, for example, by the station monitor. For example, the station monitor monitors the CCU to ensure that it is operating properly by running comparative analyses, by obtaining measurements from the diagnostics sensors.

[0069] At step **840**, other bungalow equipment is monitored. For example, a station monitor can monitor bungalow equipment such as the power supply source and the backup power supply. Additionally and/or alternatively, the station monitor can monitor any or all of the bungalow equipment as depicted in FIGS. **2** and **4**.

[0070] At step **850**, rail crossing warning systems, sensors, detectors and/or other equipment are monitored. This may be performed by the station monitor, the diagnostic sensors, and/or a combination of the two. For example, the station monitor and/or the diagnostic sensors may monitor the crossing station sensors to ensure that the measurements obtained are accurate and reliable.

[0071] At step **860**, a diagnostics report is generated and reported to a network. For example, the station monitor can generate a report that identifies any and all issues with the crossing station equipment, and transmit that report or another signal to a network.

[0072] In certain embodiments of the present technology, a method may include the steps of monitoring equipment within a bungalow installed at a rail crossing station using a station monitor installed in the bungalow. The method may also include the step of monitoring the operation of at least one rail crossing station sensor using the station monitor and one or more diagnostic sensors installed at the rail crossing station, where diagnostic sensor is in communication with the station monitor. The method may also involve generating a diagnostics report using the station monitor and transmitting the diagnostics report or otherwise communicating signals or other information over a network.

[0073] The present technology has now been described in such full, clear, concise and exact terms as to enable any person skilled in the art to which it pertains, to practice the same. It is to be understood that the foregoing describes preferred embodiments and examples of the present technology and that modifications may be made therein without departing from the spirit or scope of the invention as set forth in the claims. Moreover, it is also understood that the embodiments shown in the drawings, if any, and as described above are merely for illustrative purposes and not intended to limit the scope of the invention. As used in this description, the singular forms "a," "an," and "the" include plural reference such as "more than one" unless the context clearly dictates otherwise. Where the term "comprising" appears, it is contemplated that the terms "consisting essentially of" or "consisting of" could be used in its place to describe certain embodiments of the present technology. Further, all references cited herein are incorporated in their entirety.

1) A rail crossing remote diagnostics system comprising:

a station monitor installed in a bungalow at a rail crossing station, the station monitor having a communication module; and

a diagnostic sensor installed at the rail crossing station, the diagnostic sensor adapted to communicate with the station monitor;

wherein, the station monitor monitors at least one device installed at the rail crossing station and generates rail crossing diagnostics reports.

2) The rail crossing remote diagnostics system of claim **1**, wherein the station monitor automatically monitors at least one device installed in the bungalow.

3) The rail crossing remote diagnostics system of claim **1**, wherein the communication module transmits the rail crossing diagnostics reports to a network via the communication module.

4) The rail crossing remote diagnostics system of claim **1**, wherein the communication module allows the station monitor to be operated remotely via a network.

5) The rail crossing remote diagnostics system of claim **1**, wherein the station monitor further comprises at least one redundant backup control, the redundant backup control operating at least one rail crossing station function when the station monitor detects a problem at the rail crossing station.

6) The rail crossing remote diagnostics system of claim **1**, wherein the station monitor and the diagnostic sensor operate together to monitor the operation of at least one sensor installed at the rail crossing station.

7) The rail crossing remote diagnostics system of claim **1**, wherein the diagnostic sensor is installed at the rail crossing station external to the bungalow.

8) The rail crossing remote diagnostics system of claim **1**, wherein the diagnostic sensor is installed at the rail crossing station inside of the bungalow.

9) The rail crossing remote diagnostics system of claim **1**, further comprising two or more diagnostic sensors installed at the rail crossing station, each the diagnostic sensor adapted to communicate with the station monitor.

10) The rail crossing remote diagnostics system of claim **1**, wherein the diagnostic sensor comprises at least one of the following: a power source sensor, a gate tip sensor, a dragging equipment sensor, a wind speed monitor, a shunt sensor, an equipment temperature sensor, a video camera sensor, an ambient light sensor, a light signal sensor, a backup gate sensor, and a sound sensor.

11) The rail crossing remote diagnostics system of claim **1**, wherein the station monitor monitors the performance of at least one of the following: signal roundel lights, crossing gate lights, crossing gate tilt, crossing gate integrity, time between gate lowering and train arrival, time that a train is in the crossing area, power integrity into the bungalow, power level of a bungalow backup battery, bungalow date and time, signal integrity of a gate trigger system, and status of backup gate activation systems.

12) The rail crossing remote diagnostics system of claim **1**, wherein the station monitor further includes at least one of a bungalow intrusion alarm and a data recorder.

13) The rail crossing remote diagnostics system of claim **1**, wherein the station monitor further comprises a station monitor power system that includes a station monitor backup battery.

14) The rail crossing remote diagnostics system of claim **1**, wherein the station monitor is connected to a crossing controller unit installed in the bungalow.

15) A rail crossing diagnostics network comprising:

at least one rail crossing remote diagnostics system installed at a rail crossing station, the rail crossing remote diagnostics system comprising:

a station monitor installed in a bungalow at the rail crossing station, the station monitor having a communication module; and

a diagnostic sensor installed at the rail crossing station, the diagnostic sensor adapted to communicate with the station monitor; and

a network hub in communication with the at least one rail crossing diagnostics system;

wherein, the station monitor automatically monitors at least one device installed at the rail crossing station and generates rail crossing diagnostics reports, and further wherein the network hub provides remote access to the at least one rail crossing remote diagnostics system.

16) The rail crossing diagnostics network of claim **15**, further comprising at least two rail crossing remote diagnostics systems, wherein the network hub provides remote access to each of the at least two rail crossing remote diagnostics systems.

17) A method for automatically monitoring the operation of a rail crossing station comprising the following steps:

monitoring equipment within a bungalow installed at a rail crossing station using a station monitor installed in the bungalow;

monitoring the operation of at least one rail crossing station sensor using the station monitor and one or more diagnostic sensors installed at the rail crossing station, where the one or more diagnostic sensors are in communication with the station monitor; and

generating a diagnostics report with the station monitor.

18) The method for automatically monitoring the operation of a rail crossing station of claim **17**, further comprising the step of using the station monitor to transmit a diagnostics report over a network.

19) The method for automatically monitoring the operation of a rail crossing station of claim **17**, further comprising the steps of using the station monitor to execute a function based upon a remote command transmitted over a network.

20) The method for automatically monitoring the operation of a rail crossing station of claim **17**, further comprising the step of using the station monitor to execute a backup control operation when the station monitor detects a problem at the rail crossing station.

* * * * *

PURCHASE AGREEMENT

THIS PURCHASE AGREEMENT (this "Agreement"), dated as of 8-30-10, 2010, is entered into by and between **METROM, LLC**, an Illinois limited liability company (the "Borrower"), and **RALPH EDWARD RYBACKI** (the "Lender").

RECITALS:

A. The Borrower is seeking to raise working capital in order to carry on its business through the issuance of promissory notes and warrants.

B. Subject to the terms of this Agreement, the notes and warrants will be issued to the Lender who is an "accredited investor" as that term is defined in and pursuant to Regulation D under the Securities Act.

NOW, THEREFORE, in consideration of the premises and the agreements contained herein, and other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, the Borrower and the Lender agree as follows:

ARTICLE I

MAKING AND BORROWING OF LOANS

1.1 Making and Borrowing of the Loans. The Lender hereby agrees to make loans (each a "Loan" and collectively the "Loans") in five borrowings as follows: (i) on the Closing Date (defined in Section 6.1 below), a single borrowing consisting of a Loan in the principal amount of One Million and 00/100ths Dollars ($1,000,000.00) (the "Closing Date Loan"), and (ii) during the Delayed Draw Availability Period (defined in Section 1.1 below) below and at the sole discretion of the Borrower, up to four additional Loans with each Loan in the principal amount of Two Hundred Fifty Thousand and 00/100ths Dollars ($250,000.00) (each a "Delayed Draw Loan" and collectively the "Delayed Draw Loans") for an aggregate principal amount of One Million and 00/100ths Dollars ($1,000,000.00). The "Delayed Draw Availability Period" means the period from and including the Closing Date to the date which is the two year anniversary of the Closing Date. The aggregate principal amount of Loans that the Lender agrees to make to the Borrower pursuant to this Agreement is Two Million and 00/100ths Dollars ($2,000,000.00).

1.2 Conditions for Delayed Draw Loans; Notice. the Lender hereby agrees to make each Delayed Draw Loan within five (5) business days from request and notice by the Borrower (a "Subsequent Closing Date") upon the Borrower delivering the following to the Lender: (i) an executed copy of a Note in the principal amount of the Delayed Draw Loan payable to the Lender; and (ii) a certified statement by the Borrower's treasurer or chief financial officer that the Borrower has substantially satisfied the performance goal opposite the Delayed Draw Loan that the Borrower is noticing to be disbursed by the Lender as set forth in Section 1.3 below.

1.3 Performance Goals for Each Delayed Draw Loan. The following performance goals shall have been substantially satisfied by the Borrower prior to the making of each respective Delayed Draw Loan:

- *First Delayed Draw Loan*: Completion of Internal AFM Testing
- *Second Delayed Draw Loan*: Commencement of Gilbarco Pulser Program Shipments
- *Third Delayed Draw Loan*: Commencement of AFM Field Testing
- *Fourth Delayed Draw Loan*: Commencement of AFM Production

1.4 Terms of the Loans. The obligation of the Borrower to repay the aggregate unpaid principal amount of the Loans made hereunder by the Lender, and the terms of said obligation to repay, shall be evidenced by one or more promissory notes in the form attached hereto as Exhibit A (each, a "Note" and together, the "Notes"), dated as of the Closing Date or a Subsequent Closing Date, as applicable, made to the order of the Lender in the respective amount for either the Closing Date Loan or Delayed Draw Loan, as applicable, executed by the Borrower and bearing interest and maturing as provided in this Agreement.

The Loans shall bear simple interest at a rate of eleven percent (11.0%) per annum on the unpaid principal balance amount thereof from and including the Closing Date or a Subsequent Closing Date, as applicable, until the principal amount shall be paid in full. Each Note shall mature on the fourth anniversary date of the Closing Date or Subsequent Closing Date, as applicable (the "Maturity Date"). Interest shall be calculated on the basis of a 360 day year of twelve 30-day months, and shall be payable quarterly on the first day of each January, April, July and October. In computing such interest, the date or dates of the making of the Loans shall be included and the date of payment shall be excluded. After the Maturity Date or earlier acceleration of a Note, interest shall accrue on the outstanding principal balance of said Note at a rate of fifteen percent (15%) per annum.

ARTICLE II

ISSUANCE OF WARRANTS

2.1 Issuance of Warrants. The Borrower hereby agrees to issue warrants (each a "Warrant" and collectively the "Warrants") to the Lender as follows: (i) on the Closing Date, a Warrant to purchase sixteen and one-half percent (16.5%) of the Borrower's fully diluted equity (the "Closing Date Warrant"), and (ii) for each Delayed Draw Loan funded by the Lender upon request and notice by the Borrower, a Warrant to purchase four and one-eighth percent (4.125%) of the Borrower's fully-diluted equity (a "Delayed Draw Warrant"). In the event the Borrower requests and the Lender ultimately funds in the aggregate the Two Million and 00/100ths Dollars ($2,000,000.00) in Loans to the Borrower as provided in this Agreement, then the Warrants issued to the Lender will provide the right to purchase in the aggregate thirty-three percent (33%) of the Borrower's fully-diluted equity.

2.2 Terms of the Warrants. Each Warrant shall be issued in the form attached hereto as Exhibit B, and dated as of the Closing Date or a Subsequent Closing Date, as applicable, to

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the Lender for the right to purchase the respective percentage of the Borrower's fully-diluted equity for either the Closing Date Warrant or Delayed Draw Warranty, as applicable. Each Warrant shall have an exercise price of $0.01 per share and shall expire on the twentieth anniversary date of the date it is issued. Each Warrant, when issued in compliance with the provisions of this Agreement, shall be validly issued, fully paid and non-assessable and free of any liens or encumbrances.

ARTICLE III

REPRESENTATIONS AND WARRANTIES OF THE BORROWER

The Borrower hereby represents and warrants to the Lender that:

3.1 Organization. The Borrower is a limited liability company duly organized, existing and in good standing under the laws of the State of Illinois, with full and adequate power to carry on and conduct its business as presently conducted.

3.2 Authorization. The Borrower has full right, power and authority to enter into this Agreement, to make the borrowings and execute and deliver this Agreement, and to perform all of its duties and obligations under this Agreement. The execution and delivery of this Agreement will not, nor will the observance or performance of any of the matters and things herein or therein set forth, violate or contravene any provision of law or of the articles of organization or operating agreement of the Borrower. All necessary and appropriate action has been taken on the part of the Borrower to authorize the execution and delivery of this Agreement.

3.3 Validity and Binding Nature. This Agreement is a legal, valid and binding obligation of the Borrower, enforceable against the Borrower in accordance with its terms, subject to bankruptcy, insolvency and similar laws affecting the enforceability of creditors' rights generally and to general principles of equity.

3.4 Consent; Absence of Breach. To the Borrower's actual knowledge, the execution, delivery and performance of this Agreement does not and will not (a) require any consent, approval, authorization of, or filings with, notice to or other act by or in respect of, any governmental authority or any other person (other than any consent or approval which has been obtained and is in full force and effect); or (b) conflict with (i) any provision of law or any applicable regulation, order, writ, injunction or decree of any court or governmental authority, (ii) the articles of organization or operating agreement of the Borrower, or (iii) any material agreement, indenture, instrument or other document, or any judgment, order or decree, which is binding upon the Borrower or any of its properties or assets, except for any such violations, breaches, defaults, required consents, terminations, accelerations, encumbrances or rights that in the aggregate would not materially hinder or impair the consummation of the transactions contemplated hereby and would not have a material adverse effect.

3.5 Ownership of Properties; Liens. The Borrower is the sole owner all of the properties and assets, real and personal, tangible and intangible, of any nature whatsoever (including patents, trademarks, trade names, service marks and copyrights) that the Borrower

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expressly purports to own, free and clear of all liens, charges and claims (including, to the actual knowledge of the Borrower, infringement claims with respect to patents, trademarks, service marks, copyrights and the like), except for (a) encumbrances or liabilities set forth on the Borrower's financial statements (including personal property and capital leases, if any), (b) liens for taxes not yet due and payable, (c) minor imperfections of title, none of which, individually or in the aggregate, materially detracts from the value of the affected assets or properties, materially impairs the use of the affected assets or properties in the manner such assets or properties are currently being used, or materially impairs the operation of the Borrower, and (d) any liens, encumbrances and other matters set forth on Schedule 3.5.

3.6 Intellectual Property. To the Borrower's actual knowledge, the Borrower's use of intellectual property does not infringe upon the rights of others, and no material claim has been asserted by any Person challenging or questioning the use of any intellectual property or the validity or effectiveness of any intellectual property nor does the Borrower know of any valid basis for any such claim.

3.7 Capitalization. As of the date hereof, the Borrower has issued 100 Common Units (as defined in the Operating Agreement). Except as set forth on Schedule 3.7, the Borrower does not have any other securities or rights to purchase its securities outstanding.

3.8 Complete Information. The books of account and related records of the Borrower fairly reflect in all material respects the Borrower's assets, liabilities and transactions, it being recognized by the Lender that any projections and forecasts provided by the Borrower are based on good faith estimates and assumptions believed by the Borrower to be reasonable as of the date of the applicable projections or assumptions and that actual results during the period or periods covered by any such projections and forecasts may differ from projected or forecasted results.

ARTICLE IV

REPRESENTATIONS AND WARRANTIES OF THE LENDER

The Lender hereby represents and warrants to the Borrower that:

4.1 Organization. The Lender is an individual, lawful citizen of the United States of America, and resident of the State of Illinois.

4.2 Authorization. The Lender has full right, power and authority to enter into this Agreement and to execute, deliver, and perform under the Agreement. The execution and delivery of this Agreement will not, nor will the observance or performance of any of the matters and things herein or therein set forth, violate or contravene any provision of law or of the organizational documents, if any, that create and govern the operation of the Lender. All necessary and appropriate action has been taken on the part of the Lender to authorize the execution and delivery of this Agreement.

4.3 Validity and Binding Nature. This Agreement is the legal, valid and binding obligation of the Lender, enforceable against the Lender in accordance with its terms, subject to

bankruptcy, insolvency and similar laws affecting the enforceability of creditors' rights generally and to general principles of equity.

4.4 Investment.

(a) The Lender is an "accredited investor" within the meaning of Rule 501 under the Securities Act and was not organized for the specific purpose of acquiring the Note or Warrant;

(b) The Lender has sufficient knowledge and experience in investing in companies similar to the Borrower in terms of the Borrower's stage of development so as to be able to evaluate the risks and merits of its investment in the Borrower and it is able financially to bear the risks thereof;

(c) The Lender has had an opportunity to discuss the Borrower's business, management and financial affairs with the Borrower's management;

(d) All Notes and Warrants are being acquired for the Lender's own account for the purpose of investment and not with a view to or for sale in connection with any distribution thereof;

(e) The Lender understands that (i) neither the Notes, the Warrants nor the equity securities issuable upon exercise of each Warrant have been registered under the Securities Act by reason of their issuance in a transaction exempt from the registration requirements of the Securities Act pursuant to Section 4(2) thereof or Rule 506 promulgated under the Securities Act, (ii) if a Warrant is exercised, the equity securities issued upon conversion or exercise thereof must be held indefinitely unless a subsequent disposition thereof is registered under the Securities Act or is exempt from such registration, and the equity securities will bear a legend to such effect, and (iii) the Borrower will make a notation on its transfer books to such effect; and

(f) The Lender has had an opportunity to ask questions of, and receive answers from, the Borrower concerning the Borrower's business, management and financial affairs, which questions were answered to the Lender's satisfaction. The Lender believes that it has received all the information the Lender considers necessary or appropriate for deciding whether to make the Loans, and to acquire the Notes and Warrants.

4.5 Consent; Absence of Breach. To the Lender's actual knowledge, the execution, delivery and performance of this Agreement, and any other documents or instruments to be executed and delivered by the Lender, do not and will not (a) require any consent, approval, authorization of, or filings with, notice to or other act by or in respect of, any governmental authority or any other person (other than any consent or approval which has been obtained and is in full force and effect); or (b) conflict with (i) any provision of law or any applicable regulation, order, writ, injunction or decree of any court or governmental authority, (ii) the articles of organization or operating agreement or other governing documents of the Lender, if any, or (iii) any material agreement, indenture, instrument or other document, or any judgment, order or decree, which is binding upon the Lender or any of its properties or assets, except for any such

violations, breaches, defaults, required consents, terminations, accelerations, encumbrances or rights that in the aggregate would not materially hinder or impair the consummation of the transactions contemplated hereby and would not have a material adverse effect.

ARTICLE V

COVENANTS

5.1 Financial Statements, Reports, Etc. During the time period that there remains an outstanding balance due the Lender on the Notes, the Borrower shall at all times maintain its business records on the accrual basis of accounting and in all material respects in accordance with GAAP (except as otherwise indicated to the Lender in writing), and shall furnish to the Lender within thirty (30) days following the end of each fiscal quarter, a copy of the financial statements of the Borrower regarding such fiscal quarter, prepared and certified as true and correct by the Borrower's treasurer or chief financial officer.

5.2 Confidentiality. The Lender agrees, and any representative of the Lender will agree, to hold in confidence and trust and to act in a fiduciary manner with respect to all information provided to it or learned by it in connection with this Agreement and the business of the Borrower, except to the extent otherwise required by law and any other regulatory process to which the Lender is subject.

5.3 Transactions with Affiliates. Except as otherwise disclosed in the financial statements of the Borrower prior to the date of this Agreement, the Borrower shall not, directly or indirectly, enter into or permit to exist any transaction with any of its affiliates or with any manager, member, director, officer or employee of the Borrower other than transactions in the ordinary course of, and pursuant to the reasonable requirements of, the business of the Borrower and upon fair and reasonable terms which are fully disclosed to the Lender and are no less favorable to the Borrower than would be obtained in a comparable arm's length transaction with a party that is not an affiliate, manager, member, director, officer or employee of the Borrower.

5.4 Securities Laws. The Borrower and the Lender will take all action necessary to assure that the offer and issuance of the Notes and the Warrants are and will be exempt from the registration and prospectus delivery requirements of the Securities Act of 1933, as amended (the "Securities Act").

5.5 Management of the Borrower. The Manager of the Borrower shall be Tony Scala.

ARTICLE VI

CLOSING

6.1 The Closing Date; a Subsequent Closing Date. The closing of the Closing Date Loan made by the Lender and borrowed by the Borrower hereunder (the "Closing") shall take place as of the date hereof and at such time and/or location(s) or by such other means, including transmission of signatures by telecopy as may be agreed upon by the parties hereto (the "Closing Date"). Subject to the conditions set forth in this Agreement, the closing of the Delayed Draw Loans made by the Lender and borrowed by the Borrower hereunder (a "Subsequent Closing")

shall take place on or prior to the date which is the two year anniversary of the Closing Date and at such time and/or location(s) or by such other means, including transmission of signatures by telecopy as may be agreed upon by the parties hereto (a "Subsequent Closing Date").

6.2 Deliveries by the Borrower to the Lender. At the Closing Date or a Subsequent Closing Date, as applicable, the Borrower shall deliver or cause to be delivered to the Lender:

(a) The original Note executed by the Borrower;

(b) The original Warrant executed by the Borrower; and

(c) If a Subsequent Closing, a certified statement by the Borrower's treasurer or chief financial officer that the Borrower has substantially satisfied the performance goal opposite the Delayed Draw Loan that the Borrower is noticing to be disbursed by the Lender as set forth in Section 1.3.

6.3 Deliveries by the Lender to the Borrower. At the Closing Date or a Subsequent Closing Date, as applicable, the Lender shall deliver or cause to be delivered to the Borrower:

(a) At the Closing Date, a wire transfer or check of immediately available funds in U.S. currency in the amount for the Closing Date Loan as follows:

One Million and 00/100ths Dollars ($1,000,000.00).

ARTICLE VII

MISCELLANEOUS

7.1 Survival. The representations and warranties under this Agreement shall survive until the expiration of the six (6)-month period following the Closing Date (the "Survival Period"). No action or claim for Losses (as hereinafter defined) resulting from any misrepresentation or breach of warranty shall be brought or made after the Survival Period. "Losses" shall mean all liability, loss or damage, together with all reasonable costs and expenses related thereto (including legal and accounting fees and expenses). Notwithstanding the foregoing, the Survival Period does not apply to the Lender's representations and warranties made in Section 4.4 which representations and warranties will survive the Survival Period.

7.2 Governing Law. This Agreement shall be governed by and construed under the laws of the State of Illinois, exclusive of the provisions thereof governing conflicts of laws.

7.3 Counterparts. This Agreement may be executed in separate counterparts, each of which shall be deemed an original, but all of which together shall constitute one and the same instrument.

7.4 Titles and Subtitles. The titles and subtitles used in this Agreement are used for convenience only and are not to be considered in construing or interpreting this Agreement.

7.5 Notices. All notices, requests, demands and other communications provided for hereunder shall be in writing and addressed as follows:

To the Borrower:

Metrom, LLC
904 Donata Court
Lake Zurich, IL 60047
Attn: Tony Scala
Direct Phone: 847-847-7236
Main: 847-847-7233
Fax: 847-847-7242
Email: tony.scala@metrom-usa.com

With a Copy to:

Pittacora & Crotty, LLC
9550 W. Bormet Dr., Suite 205
Mokena, IL 60448
Attn: James R. Pittacora
Phone: (708) 390-2800
Fax: (866) 815-0555

To the Lender:

Ralph Rybacki
5560 Old Field Rd
Long Grove, IL 60047
Phone: [redacted]
Email:

or, as to each party, at such other address as shall be designated by such party in a written notice to each other party complying as to delivery with the terms of this section. All notices addressed as above shall be deemed to have been properly given (i) if served in person, upon acceptance or refusal of delivery; (ii) if mailed by certified mail, return receipt requested, postage prepaid, on the third (3rd) day following the day such notice is deposited in any post office station; or (iii) if sent by recognized overnight courier, on the first (1st) day following the day such notice is delivered to such carrier.

7.6 Amendments and Waivers. Any term of this Agreement may be amended and the observance of any term of this Agreement may be waived (either generally or in a particular instance and either retroactively or prospectively), only with the written consent of the Borrower and the Lender.

7.7 Severability. If one or more provisions of this Agreement are held to be unenforceable under applicable law, such provision shall be excluded from this Agreement and the balance of the Agreement shall be interpreted as if such provision was so excluded and shall be enforceable in accordance with its terms.

7.8 Entire Agreement. This Agreement supersedes all negotiations, representations, warranties, commitments, term sheets, discussions, negotiations, offers or contracts (of any kind

or nature, whether oral or written) prior to or contemporaneous with the execution hereof. This Agreement is the result of negotiations among the Borrower and the Lender, and have been reviewed (or have had the opportunity to be reviewed) by counsel to all such parties, and are the products of all parties. Accordingly, this Agreement shall be construed fairly as to all parties hereto and not in favor of or against any party, regardless of which party was generally responsible for the preparation of the Agreement, any documents incident hereto or any provisions therein.

7.9 Restrictive Legends. The Notes and Warrants, and the equity securities to be issued upon exercise of each Warrant, shall bear the following legends, as applicable:

> "THE SECURITIES OR NOTE REPRESENTED HEREBY WERE ISSUED IN A PRIVATE PLACEMENT, WITHOUT REGISTRATION UNDER THE SECURITIES ACT OF 1933, AS AMENDED (THE "ACT"), OR THE SECURITIES LAWS OF ANY STATE AND MAY NOT BE SOLD, TRANSFERRED, ASSIGNED, PLEDGED OR OTHERWISE DISPOSED OF IN THE ABSENCE OF AN EFFECTIVE REGISTRATION STATEMENT UNDER THE ACT AND ANY APPLICABLE STATE SECURITIES LAWS COVERING THE TRANSFER, OR THE DELIVERY TO THE COMPANY OF AN OPINION OF COUNSEL, REASONABLY SATISFACTORY TO THE COMPANY, THAT SUCH REGISTRATION IS NOT REQUIRED.
>
> UPON THE EXERCISE OF THIS WARRANT, THE COMMON UNITS WILL ALSO BE SUBJECT TO THE TERMS AND CONDITIONS OF AN OPERATING AGREEMENT BY AND AMONG THE COMPANY AND ITS MEMBERS, AS AMENDED FROM TIME TO TIME, A COPY OF WHICH AGREEMENT IS ON FILE AT THE PRINCIPAL OFFICE OF THE COMPANY. THE SALE, TRANSFER, ASSIGNMENT OR OTHER DISPOSITION OF THE SECURITIES IS SUBJECT TO THE TERMS AND CONDITIONS OF SUCH OPERATING AGREEMENT AND THE SECURITIES ARE TRANSFERABLE OR OTHERWISE DISPOSABLE ONLY UPON PROOF OF COMPLIANCE THEREWITH."

[Signature Pages Follow]

Siemens EX1002
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IN WITNESS WHEREOF, the undersigned have hereunto set their hands to this Purchase Agreement as of the day and year first above written.

THE BORROWER:

Metrom, LLC, an Illinois limited liability company

By: _____
Name: Tony Scala
Title: Manager

THE LENDER:

_____
Ralph Edward Rybacki

SCHEDULE 3.7

To the Purchase Agreement Between Metrom LLC (the "Company") and Ralph Edward Rybacki dated 5-20, 2010 for the Making of Loans to the Company in the aggregate amount of $2,000,000.00

Outstanding Warrants as of this document date:

Investor 1	6.00%
Investor 2	3.00%
Investor 3	0.60%
Investor 4	1.00%
Investor 5	1.20%
Investor 6	1.20%
Investor 7	1.20%
Investor 8	2.50%
Investor 9	1.00%
Investor 10	1.00%
Investor 11	1.20%
Investor 12	0.60%
Investor 13	1.20%
Investor 14	11.25%
Investor 15	1.20%
Team Member	2.60%
Total of Warrants	36.75%

SCHEDULE 3.5

Huntington Bank	**Equipment**
The Elgin Company	**Equipment**
Unity Financial, LLC	**Equipment**

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EXHIBIT A

THIS NOTE WAS ISSUED IN A PRIVATE PLACEMENT, WITHOUT REGISTRATION UNDER THE SECURITIES ACT OF 1933, AS AMENDED (THE "ACT"), OR THE SECURITIES LAWS OF ANY STATE AND MAY NOT BE SOLD, TRANSFERRED, ASSIGNED, PLEDGED OR OTHERWISE DISPOSED OF IN THE ABSENCE OF AN EFFECTIVE REGISTRATION STATEMENT UNDER THE ACT AND ANY APPLICABLE STATE SECURITIES LAWS COVERING THE TRANSFER, OR THE DELIVERY TO THE BORROWER OF AN OPINION OF COUNSEL, REASONABLY SATISFACTORY TO THE BORROWER THAT SUCH REGISTRATION IS NOT REQUIRED.

PROMISSORY NOTE

U.S. $1,000,000.00 May 20, 2010

1. Principal Amount. For Value Received, Metrom, LLC, an Illinois limited liability company ("BORROWER"), promises to pay to RALPH EDWARD RYBACKI ("INVESTOR"), the total principal amount of ONE MILLION AND 00/100THS DOLLARS ($1,000,000.00), on or before the date that is the fourth anniversary date of the date this Note (defined in Section 2 below) was issued (the "Maturity Date"), together with interest thereon at the rate or rates described below, and any and all other amounts which may be due and payable hereunder.

2. Interest. Simple interest shall accrue on the principal balance of this promissory note (this "Note") outstanding from the date hereof through the Maturity Date at an annual rate of interest equal to eleven percent (11.0%). Interest on this Note shall be calculated on the basis of a 360 day year of twelve 30-day months, and shall be payable quarterly on the first day of each January, April, July and October. In computing such interest, the date of this Note shall be included and the date of payment shall be excluded. After the Maturity Date or earlier acceleration of this Note, interest shall accrue on the outstanding principal balance at an annual rate of interest equal to fifteen percent (15%).

3. Payments. BORROWER is not obligated to make payments toward the reduction of the principal balance of this Note until the Maturity Date or upon the earlier acceleration of this Note. BORROWER, without notice, premium or penalty, may prepay this Note in whole or in part.

4. Events of Default. The occurrence of any one or more of the following events shall constitute an event of default ("Event of Default") under this Note:

(a) Payment Default. BORROWER shall fail to pay any principal or interest of this Note when due, whether at maturity, by acceleration or otherwise, and such failure shall continue for ten (10) days after the date due.

(b) Breach of Representation or Warranty. A material breach of a representation or warranty contained in that certain Purchase Agreement between BORROWER and INVESTOR dated 5 20, 2010, as amended from time to time, providing for the issuance of this Note (the "Purchase Agreement").

(c) Breach of Covenant. BORROWER shall breach or fail to observe any covenant contained herein or the Purchase Agreement between BORROWER and INVESTOR, and such failure shall continue for thirty (30) days.

(d) Bankruptcy, Etc. BORROWER becomes insolvent or generally fails to pay its debts as they mature; or BORROWER applies for, consents to or acquiesces in the appointment of a trustee in bankruptcy, receiver or other custodian for BORROWER or any of its property or assets, or BORROWER makes a general assignment for the benefit of its creditors; or, in the absence of such application, consent or acquiescence, a trustee, receiver or other custodian is appointed for BORROWER or for a substantial part of its property or assets and such appointment is not discharged within sixty (60) days thereafter; or any bankruptcy, reorganization, debt arrangement or other case or proceeding under any bankruptcy or insolvency law, or any liquidation proceeding is commenced in respect of BORROWER and, if such case or proceeding is not commenced by BORROWER, it is either (i) consented to or acquiesced in by BORROWER, or (ii) remains un-dismissed for sixty (60) days.

5. Remedies. At the election of INVESTOR, the principal balance remaining unpaid under this Note, and all unpaid interest accrued thereon and any other amounts due hereunder, shall be and become immediately due and payable in full upon the occurrence of any Event of Default. Failure to exercise this option shall not constitute a waiver of the right to exercise same in the event of any subsequent Event of Default. INVESTOR shall not, by any act of omission or commission, be deemed to waive any of its rights, remedies or powers hereunder or otherwise unless such waiver is in writing and signed by INVESTOR, and then only to the extent specifically set forth therein. If any suit or action is instituted or attorneys are employed to collect this Note or any part hereof, BORROWER promises and agrees to pay all costs of collection, including reasonable attorneys' fees and court costs. The Borrower hereby waives presentment and demand for payment, notices of nonpayment and of dishonor, protest of dishonor, and notice of protest. Time is of the essence hereof.

6. Amendments; Waivers. This Note may not be modified except by written agreement signed by BORROWER and INVESTOR, and no provision hereof or breach thereof may be waived except in writing. The waiver of any term hereof or the breach thereof in any instance shall not be deemed to be a waiver of such term or breach in any other instance or of any other term or breach.

7. Governing Law. This Note is made under and governed in all respects by the laws of the State of Illinois (without regard to the conflicts of law principles thereof).

8. Venue and Jury Trial Waiver. BORROWER consents to the exclusive jurisdiction of the State and Federal Courts in the City of Chicago, State of Illinois, in the case of any dispute, claim, or controversy arising hereunder in any such proceeding, both INVESTOR and BORROWER shall each waive their rights to a trial by jury.

IN WITNESS WHEREOF, BORROWER has executed and delivered this Note as of the date first above written.

METROM, LLC, an Illinois limited liability company

By: _____

Name: Tony Scala
Title: Manager

EXHIBIT B

THE WARRANT REPRESENTED HEREBY WAS ISSUED IN A PRIVATE PLACEMENT, WITHOUT REGISTRATION UNDER THE SECURITIES ACT OF 1933, AS AMENDED (THE "ACT"), OR THE SECURITIES LAWS OF ANY STATE AND MAY NOT BE SOLD, TRANSFERRED, ASSIGNED, PLEDGED OR OTHERWISE DISPOSED OF IN THE ABSENCE OF AN EFFECTIVE REGISTRATION STATEMENT UNDER THE ACT AND ANY APPLICABLE STATE SECURITIES LAWS COVERING THE TRANSFER, OR THE DELIVERY TO THE COMPANY OF AN OPINION OF COUNSEL, REASONABLY SATISFACTORY TO THE COMPANY, THAT SUCH REGISTRATION IS NOT REQUIRED.

UPON THE EXERCISE OF THIS WARRANT, THE COMMON UNITS WILL ALSO BE SUBJECT TO THE TERMS AND CONDITIONS OF AN OPERATING AGREEMENT BY AND AMONG THE COMPANY AND ITS MEMBERS, AS AMENDED FROM TIME TO TIME, A COPY OF WHICH AGREEMENT IS ON FILE AT THE PRINCIPAL OFFICE OF THE COMPANY. THE SALE, TRANSFER, ASSIGNMENT OR OTHER DISPOSITION OF THE SECURITIES IS SUBJECT TO THE TERMS AND CONDITIONS OF SUCH OPERATING AGREEMENT AND THE SECURITIES ARE TRANSFERABLE OR OTHERWISE DISPOSABLE ONLY UPON PROOF OF COMPLIANCE THEREWITH.

METROM, LLC, AN ILLINOIS LIMITED LIABILITY COMPANY

WARRANT TO PURCHASE COMMON UNITS

No. W-__

May 20, 2010

Void on the Twentieth Anniversary Date of the Date This Warrant is Issued

THIS CERTIFIES THAT, for value received, **RALPH EDWARD RYBACKI** (the "Holder"), is entitled to subscribe for and purchase from **METROM, LLC**, an Illinois limited liability company (the "Company") up to sixteen and one-half percent (16.5%) of the fully-diluted equity of the Company (which are currently represented by the Company's Common Units, the "Common Units") of the Company, upon surrender hereof, at the principal office of the Company, with the subscription form attached hereto duly executed, and simultaneous payment therefor as hereinafter provided, at the Exercise Price as set forth herein. The term "Warrant" as used herein shall include this Warrant and any warrants delivered in substitution or exchange therefor as provided herein. This Warrant was issued in connection with that certain Purchase Agreement dated 5-20, 2010 by and between the Company and the Holder (as amended from time to time and in effect, the "Purchase Agreement"). The Company shall register this Warrant in the Company's books and records.

1. Term of Warrant and Exercise. Subject to the terms and conditions set forth herein and the Purchase Agreement, this Warrant shall be exercisable, at any time or from time to time, in whole or in part, at the sole option of the Holder, without any obligation to do so, during the term commencing the date this Warrant was issued and dated above, and ending at 5:00 p.m. on the date that is the twentieth anniversary date of the date of this Warrant (the

"Warrant Term"). The exercise price at which this Warrant may be exercised shall be $0.001 per Common Unit up to a maximum aggregate price of $100 (the "Exercise Price").

2. Exercise of Warrant.

2.1 Subject to the terms of this Warrant and the Purchase Agreement, the purchase rights represented by this Warrant are exercisable in whole or in part by the Holder, solely at the discretion of the Holder, during the Warrant Term by surrender of this Warrant and the attached Notice of Exercise, duly completed and executed on behalf of the Holder, at the principal office of the Company, upon payment of the Exercise Price in the form of (i) cash or by certified check to the Company, (ii) cancellation by the Holder of indebtedness of the Company to the Holder, or (iii) by a combination of (i) and (ii) above, it being the intent of the parties that the total value to the Company, through cash or forgiveness of indebtedness, equal the Exercise Price.

2.2 This Warrant shall be deemed to have been exercised immediately prior to the close of business on the date of its surrender for exercise as provided above, and the person entitled to receive the Common Units issuable upon such exercise shall be treated for all purposes as the holder of record of such Common Units as of the close of business on such date. As promptly as practicable on or after such date and in any event within ten (10) days thereafter, the Company at its expense shall issue and deliver to the person or persons entitled to receive the same a certificate or certificates for the number of Common Units issuable upon such exercise. In the event that this Warrant is exercised in part, the Company at its expense will execute and deliver a new Warrant of like tenor exercisable for the number of Common Units for which this Warrant may then be exercised.

3. Covenants. The Company covenants that Common Units that may be issued upon the exercise of rights represented by this Warrant, upon exercise of the rights represented by this Warrant and payment of the Exercise Price, all as set forth herein, will be duly authorized, validly issued, fully paid and non-assessable and free from all taxes, liens and charges in respect of the issue thereof.

4 Expenses from Issuance and Exercise. The Company shall pay all expenses and taxes imposed by law or any governmental agency, including any documentary stamp taxes, directly resulting from the issuance of Common Units upon the exercise of the Warrant.

5. Redemption. This Warrant and/or the Common Units issued in connection with an exercise of this Warrant are redeemable as set forth in the Purchase Agreement.

6. Amendments and Waivers. Any term of this Warrant may be amended and the observance of any term of this Warrant may be waived (either generally or in a particular instance and either retroactively or prospectively), only with the written consent of both the Company and the Holder. Any such amendment or waiver shall be binding on the parties.

7. Severability. If one or more provisions of this Warrant are held to be unenforceable under applicable law, such provision shall be excluded from this Warrant and the

balance of this Warrant shall be interpreted as if such provision were so excluded and shall be enforceable in accordance with its terms.

8. Governing Law. The terms and conditions of this Warrant shall be governed by and construed in accordance with the laws of the State of Illinois without regard to such State's choice of law provisions.

9. Titles and Subtitles. The titles and subtitles used in this Warrant are used for convenience only and are not to be considered in construing or interpreting this Warrant.

10. Notices. Unless otherwise provided, any notice required or permitted under this Warrant shall be given in writing and shall be delivered as set forth in the Purchase Agreement.

11. Lost Warrants. The Company represents and warrants to the Holder hereof that upon receipt of evidence reasonably satisfactory to the Company of the loss, theft, destruction, or mutilation of this Warrant and, in the case of any such loss, theft or destruction, upon receipt of an affidavit and indemnity by the Holder reasonably satisfactory to the Company, or in the case of any such mutilation upon surrender and cancellation of such Warrant, the Company, at its expense, will make and deliver a new Warrant, of like tenor, in lieu of the lost, stolen, destroyed or mutilated Warrant.

IN WITNESS WHEREOF, the Company has caused this Warrant to be duly executed as of May 20, 2010.

METROM, LLC, an Illinois limited liability company

By: _____
Name: Tony Scala
Title: Manager

NOTICE OF EXERCISE

To: **METROM, LLC**

Attn:

The undersigned hereby elects to purchase _____ percent (____%) of the Common Units of **METROM, LLC**, an Illinois limited liability company (the "Company"), at an Exercise Price as set forth in Section 1 of that certain Warrant for the Purchase of Common Units dated May __, 2010 (the "Warrant").

The undersigned requests that the Company issue the Common Units in the name of the undersigned or in such other name as is specified below:

_____
(Print Name)

By its signature below, the undersigned hereby confirms and acknowledges that the Common Units issuable upon exercise of the Warrant are being acquired solely for the account of the undersigned and not as a nominee for any other party, and for investment.

Date: _____

Very truly yours,

_____
(Print Name)

_____
(Signature)

By: _____
(Name and title of signatory, if non-natural person)

CONSENT AND WAIVER BY OWNER, LANDLORD OR MORTGAGEE OF REAL ESTATE

The undersigned, RER LLC 5560 OLD RIELD RD Lake Grove IL 60047
(Name of Landlord) (Street Address. City or Town. State)
is the owner, landlord or mortgagee of the premises located at
Lake Zurich, IL 60047
("Premises") which are occupied by Metrom, LLC ("Occupant").

The undersigned acknowledges that UNITY FINANCIAL, LLC is the owner of, or now has, or will acquire, a first security interest under a Master Lease Agreement, Master Loan and Security Agreement or Security Agreement (the "Contract") in, the machinery, equipment, or other personal property described on Exhibit A annexed hereto and made a part hereof, ("Equipment") including any accessories, additions, substitutions or replacements therefor, which may from time to time be located at the Premises.

To induce UNITY FINANCIAL, LLC to enter into the Contract with Occupant, the undersigned: irrevocably waives any right, title or interest in or to the Equipment that the undersigned may now or hereafter have; will refrain from taking any action to bar, restrain or otherwise prevent UNITY FINANCIAL, LLC, its agents, successors or assigns, from entering the Premises for the purpose of inspecting, removing or taking possession of the Equipment; hereby grants UNITY FINANCIAL, LLC, its agents, successors or assigns the right of entry to the Premises to remove the Equipment at any reasonable time or times; agrees that the Equipment is, and shall remain personal property, notwithstanding the manner in which it is installed or affixed to the Premises.

The undersigned shall notify UNITY FINANCIAL, LLC in the event the Equipment remains at the Premises after either (i) Occupant is evicted from the Premises or (ii) Occupant leaves, abandons or vacates the Premises. The undersigned shall have 15 days to remove the Equipment from the Premises after such notification, which shall be provided in writing to Lynnea Walsh at Lynneawalsh@comcast.net.

This Consent and Waiver shall inure to the benefit of the successors and assignees of UNITY FINANCIAL, LLC and shall be binding upon the heirs, representatives, successors and assigns of the undersigned.

In Witness Whereof, the undersigned has duly executed this Consent and Waiver this _____day of July, 2010.

LANDLORD

RER LLC

Ralph Rydnicki
(NAME OF LANDLORD)

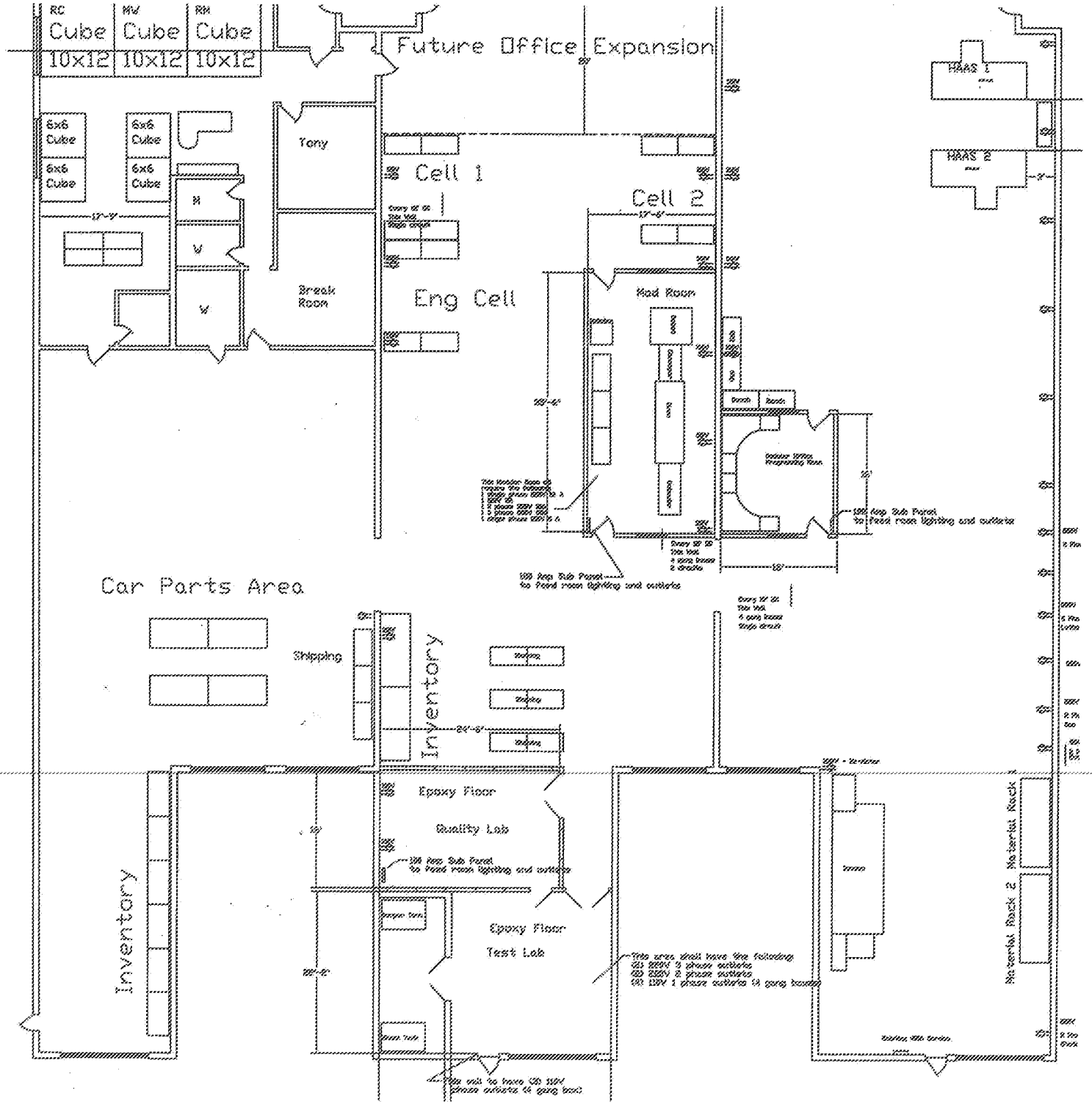
By: X Ralph Rydnicki
(LANDLORD's SIGNATURE)

Title: Owner
(LANDLORD's TITLE)

Date: 8-9-10

Witness

Date


RC
Cube
10x12
RM
Cube
10x12
RM
Cube
10x12
Future Office Expansion
6x6
Cube
6x6
Cube
6x6
Cube
6x6
Cube
Tony
Break
Room
Cell 1
Cell 2
Eng Cell
Mod Room
HAAS 1
HAAS 2
Car Parts Area
Shipping
Inventory
Epoxy Floor
Quality Lab
Epoxy Floor
Test Lab
Inventory
Material Rack 2
Material Rack 1

8-4-10

THIS NOTE WAS ISSUED IN A PRIVATE PLACEMENT, WITHOUT REGISTRATION UNDER THE SECURITIES ACT OF 1933, AS AMENDED (THE "ACT"), OR THE SECURITIES LAWS OF ANY STATE AND MAY NOT BE SOLD, TRANSFERRED, ASSIGNED, PLEDGED OR OTHERWISE DISPOSED OF IN THE ABSENCE OF AN EFFECTIVE REGISTRATION STATEMENT UNDER THE ACT AND ANY APPLICABLE STATE SECURITIES LAWS COVERING THE TRANSFER, OR THE DELIVERY TO THE BORROWER OF AN OPINION OF COUNSEL, REASONABLY SATISFACTORY TO THE BORROWER THAT SUCH REGISTRATION IS NOT REQUIRED.

PROMISSORY NOTE

U.S. $250,000 August 4, 2010

1. Principal Amount. For Value Received, Metrom, LLC, an Illinois limited liability company ("BORROWER"), promises to pay to RALPH EDWARD RYBACKI ("INVESTOR"), the total principal amount of TWO-HUNDRED FIFTY-THOUSAND DOLLARS ($250,000), on or before the date that is the fourth anniversary date of the date this Note (defined in Section 2 below) was issued (the "Maturity Date"), together with interest thereon at the rate or rates described below, and any and all other amounts which may be due and payable hereunder.

2. Interest. Simple interest shall accrue on the principal balance of this promissory note (this "Note") outstanding from the date hereof through the Maturity Date at an annual rate of interest equal to eleven percent (11.0%). Interest on this Note shall be calculated on the basis of a 360 day year of twelve 30-day months, and shall be payable quarterly on the first day of each January, April, July and October. In computing such interest, the date of this Note shall be included and the date of payment shall be excluded. After the Maturity Date or earlier acceleration of this Note, interest shall accrue on the outstanding principal balance at an annual rate of interest equal to fifteen percent (15%).

3. Payments. BORROWER is not obligated to make payments toward the reduction of the principal balance of this Note until the Maturity Date or upon the earlier acceleration of this Note. BORROWER, without notice, premium or penalty, may prepay this Note in whole or in part.

4. Events of Default. The occurrence of any one or more of the following events shall constitute an event of default ("Event of Default") under this Note:

(a) Payment Default. BORROWER shall fail to pay any principal or interest of this Note when due, whether at maturity, by acceleration or otherwise, and such failure shall continue for ten (10) days after the date due.

(b) Breach of Representation or Warranty. A material breach of a representation or warranty contained in that certain Purchase Agreement between BORROWER and INVESTOR dated MAY 20, 2010, as amended from time to time, providing for the issuance of this Note (the "Purchase Agreement").

(c) Breach of Covenant. BORROWER shall breach or fail to observe any covenant contained herein or the Purchase Agreement between BORROWER and INVESTOR, and such failure shall continue for thirty (30) days.

(d) Bankruptcy, Etc. BORROWER becomes insolvent or generally fails to pay its debts as they mature; or BORROWER applies for, consents to or acquiesces in the appointment of a trustee in bankruptcy, receiver or other custodian for BORROWER or any of its property or assets, or BORROWER makes a general assignment for the benefit of its creditors; or, in the absence of such application, consent or acquiescence, a trustee, receiver or other custodian is appointed for BORROWER or for a substantial part of its property or assets and such appointment is not discharged within sixty (60) days thereafter; or any bankruptcy, reorganization, debt arrangement or other case or proceeding under any bankruptcy or insolvency law, or any liquidation proceeding is commenced in respect of BORROWER and, if such case or proceeding is not commenced by BORROWER, it is either (i) consented to or acquiesced in by BORROWER, or (ii) remains un-dismissed for sixty (60) days.

5. Remedies. At the election of INVESTOR, the principal balance remaining unpaid under this Note, and all unpaid interest accrued thereon and any other amounts due hereunder, shall be and become immediately due and payable in full upon the occurrence of any Event of Default. Failure to exercise this option shall not constitute a waiver of the right to exercise same in the event of any subsequent Event of Default. INVESTOR shall not, by any act of omission or commission, be deemed to waive any of its rights, remedies or powers hereunder or otherwise unless such waiver is in writing and signed by INVESTOR, and then only to the extent specifically set forth therein. If any suit or action is instituted or attorneys are employed to collect this Note or any part hereof, BORROWER promises and agrees to pay all costs of collection, including reasonable attorneys' fees and court costs. The Borrower hereby waives presentment and demand for payment, notices of nonpayment and of dishonor, protest of dishonor, and notice of protest. Time is of the essence hereof.

6. Amendments; Waivers. This Note may not be modified except by written agreement signed by BORROWER and INVESTOR, and no provision hereof or breach thereof may be waived except in writing. The waiver of any term hereof or the breach thereof in any instance shall not be deemed to be a waiver of such term or breach in any other instance or of any other term or breach.

7. Governing Law. This Note is made under and governed in all respects by the laws of the State of Illinois (without regard to the conflicts of law principles thereof).

8. Venue and Jury Trial Waiver. BORROWER consents to the exclusive jurisdiction of the State and Federal Courts in the City of Chicago, State of Illinois, in the case of any dispute, claim, or controversy arising hereunder in any such proceeding, both INVESTOR and BORROWER shall each waive their rights to a trial by jury.

IN WITNESS WHEREOF, BORROWER has executed and delivered this Note as of the date first above written.

METROM, LLC, an Illinois limited liability company

By: _____

Name: Tony Scala
Title: Manager

THE WARRANT REPRESENTED HEREBY WAS ISSUED IN A PRIVATE PLACEMENT, WITHOUT REGISTRATION UNDER THE SECURITIES ACT OF 1933, AS AMENDED (THE "ACT"), OR THE SECURITIES LAWS OF ANY STATE AND MAY NOT BE SOLD, TRANSFERRED, ASSIGNED, PLEDGED OR OTHERWISE DISPOSED OF IN THE ABSENCE OF AN EFFECTIVE REGISTRATION STATEMENT UNDER THE ACT AND ANY APPLICABLE STATE SECURITIES LAWS COVERING THE TRANSFER, OR THE DELIVERY TO THE COMPANY OF AN OPINION OF COUNSEL, REASONABLY SATISFACTORY TO THE COMPANY, THAT SUCH REGISTRATION IS NOT REQUIRED.

UPON THE EXERCISE OF THIS WARRANT, THE COMMON UNITS WILL ALSO BE SUBJECT TO THE TERMS AND CONDITIONS OF AN OPERATING AGREEMENT BY AND AMONG THE COMPANY AND ITS MEMBERS, AS AMENDED FROM TIME TO TIME, A COPY OF WHICH AGREEMENT IS ON FILE AT THE PRINCIPAL OFFICE OF THE COMPANY. THE SALE, TRANSFER, ASSIGNMENT OR OTHER DISPOSITION OF THE SECURITIES IS SUBJECT TO THE TERMS AND CONDITIONS OF SUCH OPERATING AGREEMENT AND THE SECURITIES ARE TRANSFERABLE OR OTHERWISE DISPOSABLE ONLY UPON PROOF OF COMPLIANCE THEREWITH.

METROM, LLC, AN ILLINOIS LIMITED LIABILITY COMPANY

WARRANT TO PURCHASE COMMON UNITS

August 4, 2010

Void on the Twentieth Anniversary Date of the Date This Warrant is Issued

THIS CERTIFIES THAT, for value received, **RALPH EDWARD RYBACKI** (the "Holder"), is entitled to subscribe for and purchase from **METROM, LLC**, an Illinois limited liability company (the "Company") up to FOUR and ONE HUNDRED TWENTY FIVE THOUSANDTHS percent (4.125%) of the fully-diluted equity of the Company (which are currently represented by the Company's Common Units, the "Common Units") of the Company, upon surrender hereof, at the principal office of the Company, with the subscription form attached hereto duly executed, and simultaneous payment therefor as hereinafter provided, at the Exercise Price as set forth herein. The term "Warrant" as used herein shall include this Warrant and any warrants delivered in substitution or exchange therefor as provided herein. This Warrant was issued in connection with that certain Purchase Agreement dated MAY 20, 2010 by and between the Company and the Holder (as amended from time to time and in effect, the "Purchase Agreement"). The Company shall register this Warrant in the Company's books and records.

1. Term of Warrant and Exercise. Subject to the terms and conditions set forth herein and the Purchase Agreement, this Warrant shall be exercisable, at any time or from time to time, in whole or in part, at the sole option of the Holder, without any obligation to do so, during the term commencing the date this Warrant was issued and dated above, and ending at 5:00 p.m. on the date that is the twentieth anniversary date of the date of this Warrant (the

"Warrant Term"). The exercise price at which this Warrant may be exercised shall be $0.001 per Common Unit up to a maximum aggregate price of $100 (the "Exercise Price").

2. Exercise of Warrant.

2.1 Subject to the terms of this Warrant and the Purchase Agreement, the purchase rights represented by this Warrant are exercisable in whole or in part by the Holder, solely at the discretion of the Holder, during the Warrant Term by surrender of this Warrant and the attached Notice of Exercise, duly completed and executed on behalf of the Holder, at the principal office of the Company, upon payment of the Exercise Price in the form of (i) cash or by certified check to the Company, (ii) cancellation by the Holder of indebtedness of the Company to the Holder, or (iii) by a combination of (i) and (ii) above, it being the intent of the parties that the total value to the Company, through cash or forgiveness of indebtedness, equal the Exercise Price.

2.2 This Warrant shall be deemed to have been exercised immediately prior to the close of business on the date of its surrender for exercise as provided above, and the person entitled to receive the Common Units issuable upon such exercise shall be treated for all purposes as the holder of record of such Common Units as of the close of business on such date. As promptly as practicable on or after such date and in any event within ten (10) days thereafter, the Company at its expense shall issue and deliver to the person or persons entitled to receive the same a certificate or certificates for the number of Common Units issuable upon such exercise. In the event that this Warrant is exercised in part, the Company at its expense will execute and deliver a new Warrant of like tenor exercisable for the number of Common Units for which this Warrant may then be exercised.

3. Covenants. The Company covenants that Common Units that may be issued upon the exercise of rights represented by this Warrant, upon exercise of the rights represented by this Warrant and payment of the Exercise Price, all as set forth herein, will be duly authorized, validly issued, fully paid and non-assessable and free from all taxes, liens and charges in respect of the issue thereof.

4 Expenses from Issuance and Exercise. The Company shall pay all expenses and taxes imposed by law or any governmental agency, including any documentary stamp taxes, directly resulting from the issuance of Common Units upon the exercise of the Warrant.

5. Redemption. This Warrant and/or the Common Units issued in connection with an exercise of this Warrant are redeemable as set forth in the Purchase Agreement.

6. Amendments and Waivers. Any term of this Warrant may be amended and the observance of any term of this Warrant may be waived (either generally or in a particular instance and either retroactively or prospectively), only with the written consent of both the Company and the Holder. Any such amendment or waiver shall be binding on the parties.

7. Severability. If one or more provisions of this Warrant are held to be unenforceable under applicable law, such provision shall be excluded from this Warrant and the

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balance of this Warrant shall be interpreted as if such provision were so excluded and shall be enforceable in accordance with its terms.

8. Governing Law. The terms and conditions of this Warrant shall be governed by and construed in accordance with the laws of the State of Illinois without regard to such State's choice of law provisions.

9. Titles and Subtitles. The titles and subtitles used in this Warrant are used for convenience only and are not to be considered in construing or interpreting this Warrant.

10. Notices. Unless otherwise provided, any notice required or permitted under this Warrant shall be given in writing and shall be delivered as set forth in the Purchase Agreement.

11. Lost Warrants. The Company represents and warrants to the Holder hereof that upon receipt of evidence reasonably satisfactory to the Company of the loss, theft, destruction, or mutilation of this Warrant and, in the case of any such loss, theft or destruction, upon receipt of an affidavit and indemnity by the Holder reasonably satisfactory to the Company, or in the case of any such mutilation upon surrender and cancellation of such Warrant, the Company, at its expense, will make and deliver a new Warrant, of like tenor, in lieu of the lost, stolen, destroyed or mutilated Warrant.

IN WITNESS WHEREOF, the Company has caused this Warrant to be duly executed as of August 4, 2010.

METROM, LLC, an Illinois limited liability company

By: _____
Name: Tony Scala
Title: Manager

NOTICE OF EXERCISE

To: **METROM, LLC**

Attn:

The undersigned hereby elects to purchase _____ percent (____%) of the Common Units of **METROM, LLC**, an Illinois limited liability company (the "Company"), at an Exercise Price as set forth in Section 1 of that certain Warrant for the Purchase of Common Units dated _____ ___, 20__ (the "Warrant").

The undersigned requests that the Company issue the Common Units in the name of the undersigned or in such other name as is specified below:

_____
(Print Name)

By its signature below, the undersigned hereby confirms and acknowledges that the Common Units issuable upon exercise of the Warrant are being acquired solely for the account of the undersigned and not as a nominee for any other party, and for investment.

Date: _____

Very truly yours,

_____
(Print Name)

_____
(Signature)

By: _____
(Name and title of signatory, if non-natural person)

THIS NOTE WAS ISSUED IN A PRIVATE PLACEMENT, WITHOUT REGISTRATION UNDER THE SECURITIES ACT OF 1933, AS AMENDED (THE "ACT"), OR THE SECURITIES LAWS OF ANY STATE AND MAY NOT BE SOLD, TRANSFERRED, ASSIGNED, PLEDGED OR OTHERWISE DISPOSED OF IN THE ABSENCE OF AN EFFECTIVE REGISTRATION STATEMENT UNDER THE ACT AND ANY APPLICABLE STATE SECURITIES LAWS COVERING THE TRANSFER, OR THE DELIVERY TO THE BORROWER OF AN OPINION OF COUNSEL, REASONABLY SATISFACTORY TO THE BORROWER THAT SUCH REGISTRATION IS NOT REQUIRED.

PROMISSORY NOTE

U.S. $250,000 September 17, 2010

1. Principal Amount. For Value Received, Metrom, LLC, an Illinois limited liability company ("BORROWER"), promises to pay to RALPH EDWARD RYBACKI ("INVESTOR"), the total principal amount of _TWO-HUNDRED FIFTY-THOUSAND DOLLARS ($250,000), on or before the date that is the fourth anniversary date of the date this Note (defined in Section 2 below) was issued (the "Maturity Date"), together with interest thereon at the rate or rates described below, and any and all other amounts which may be due and payable hereunder.

2. Interest. Simple interest shall accrue on the principal balance of this promissory note (this "Note") outstanding from the date hereof through the Maturity Date at an annual rate of interest equal to eleven percent (11.0%). Interest on this Note shall be calculated on the basis of a 360 day year of twelve 30-day months, and shall be payable quarterly on the first day of each January, April, July and October. In computing such interest, the date of this Note shall be included and the date of payment shall be excluded. After the Maturity Date or earlier acceleration of this Note, interest shall accrue on the outstanding principal balance at an annual rate of interest equal to fifteen percent (15%).

3. Payments. BORROWER is not obligated to make payments toward the reduction of the principal balance of this Note until the Maturity Date or upon the earlier acceleration of this Note. BORROWER, without notice, premium or penalty, may prepay this Note in whole or in part.

4. Events of Default. The occurrence of any one or more of the following events shall constitute an event of default ("Event of Default") under this Note:

(a) Payment Default. BORROWER shall fail to pay any principal or interest of this Note when due, whether at maturity, by acceleration or otherwise, and such failure shall continue for ten (10) days after the date due.

(b) Breach of Representation or Warranty. A material breach of a representation or warranty contained in that certain Purchase Agreement between BORROWER and INVESTOR dated MAY 20, 2010, as amended from time to time, providing for the issuance of this Note (the "Purchase Agreement").

(c) Breach of Covenant. BORROWER shall breach or fail to observe any covenant contained herein or the Purchase Agreement between BORROWER and INVESTOR, and such failure shall continue for thirty (30) days.

(d) Bankruptcy, Etc. BORROWER becomes insolvent or generally fails to pay its debts as they mature; or BORROWER applies for, consents to or acquiesces in the appointment of a trustee in bankruptcy, receiver or other custodian for BORROWER or any of its property or assets, or BORROWER makes a general assignment for the benefit of its creditors; or, in the absence of such application, consent or acquiescence, a trustee, receiver or other custodian is appointed for BORROWER or for a substantial part of its property or assets and such appointment is not discharged within sixty (60) days thereafter; or any bankruptcy, reorganization, debt arrangement or other case or proceeding under any bankruptcy or insolvency law, or any liquidation proceeding is commenced in respect of BORROWER and, if such case or proceeding is not commenced by BORROWER, it is either (i) consented to or acquiesced in by BORROWER, or (ii) remains un-dismissed for sixty (60) days.

5. Remedies. At the election of INVESTOR, the principal balance remaining unpaid under this Note, and all unpaid interest accrued thereon and any other amounts due hereunder, shall be and become immediately due and payable in full upon the occurrence of any Event of Default. Failure to exercise this option shall not constitute a waiver of the right to exercise same in the event of any subsequent Event of Default. INVESTOR shall not, by any act of omission or commission, be deemed to waive any of its rights, remedies or powers hereunder or otherwise unless such waiver is in writing and signed by INVESTOR, and then only to the extent specifically set forth therein. If any suit or action is instituted or attorneys are employed to collect this Note or any part hereof, BORROWER promises and agrees to pay all costs of collection, including reasonable attorneys' fees and court costs. The Borrower hereby waives presentment and demand for payment, notices of nonpayment and of dishonor, protest of dishonor, and notice of protest. Time is of the essence hereof.

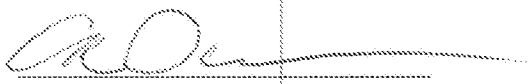
6. Amendments; Waivers. This Note may not be modified except by written agreement signed by BORROWER and INVESTOR, and no provision hereof or breach thereof may be waived except in writing. The waiver of any term hereof or the breach thereof in any instance shall not be deemed to be a waiver of such term or breach in any other instance or of any other term or breach.

7. Governing Law. This Note is made under and governed in all respects by the laws of the State of Illinois (without regard to the conflicts of law principles thereof).

8. Venue and Jury Trial Waiver. BORROWER consents to the exclusive jurisdiction of the State and Federal Courts in the City of Chicago, State of Illinois, in the case of any dispute, claim, or controversy arising hereunder in any such proceeding, both INVESTOR and BORROWER shall each waive their rights to a trial by jury.

IN WITNESS WHEREOF, BORROWER has executed and delivered this Note as of the date first above written.

METROM, LLC, an Illinois limited liability company

By: 

Name: Tony Scala
Title: Manager

THE WARRANT REPRESENTED HEREBY WAS ISSUED IN A PRIVATE PLACEMENT, WITHOUT REGISTRATION UNDER THE SECURITIES ACT OF 1933, AS AMENDED (THE "ACT"), OR THE SECURITIES LAWS OF ANY STATE AND MAY NOT BE SOLD, TRANSFERRED, ASSIGNED, PLEDGED OR OTHERWISE DISPOSED OF IN THE ABSENCE OF AN EFFECTIVE REGISTRATION STATEMENT UNDER THE ACT AND ANY APPLICABLE STATE SECURITIES LAWS COVERING THE TRANSFER, OR THE DELIVERY TO THE COMPANY OF AN OPINION OF COUNSEL, REASONABLY SATISFACTORY TO THE COMPANY, THAT SUCH REGISTRATION IS NOT REQUIRED.

UPON THE EXERCISE OF THIS WARRANT, THE COMMON UNITS WILL ALSO BE SUBJECT TO THE TERMS AND CONDITIONS OF AN OPERATING AGREEMENT BY AND AMONG THE COMPANY AND ITS MEMBERS, AS AMENDED FROM TIME TO TIME, A COPY OF WHICH AGREEMENT IS ON FILE AT THE PRINCIPAL OFFICE OF THE COMPANY. THE SALE, TRANSFER, ASSIGNMENT OR OTHER DISPOSITION OF THE SECURITIES IS SUBJECT TO THE TERMS AND CONDITIONS OF SUCH OPERATING AGREEMENT AND THE SECURITIES ARE TRANSFERABLE OR OTHERWISE DISPOSABLE ONLY UPON PROOF OF COMPLIANCE THEREWITH.

METROM, LLC, AN ILLINOIS LIMITED LIABILITY COMPANY

WARRANT TO PURCHASE COMMON UNITS

September 17, 2010

Void on the Twentieth Anniversary Date of the Date This Warrant is Issued

THIS CERTIFIES THAT, for value received, **RALPH EDWARD RYBACKI** (the "Holder"), is entitled to subscribe for and purchase from **METROM, LLC**, an Illinois limited liability company (the "Company") up to FOUR and ONE HUNDRED TWENTY FIVE THOUSANDTHS percent (4.125%) of the fully-diluted equity of the Company (which are currently represented by the Company's Common Units, the "Common Units") of the Company, upon surrender hereof, at the principal office of the Company, with the subscription form attached hereto duly executed, and simultaneous payment therefor as hereinafter provided, at the Exercise Price as set forth herein. The term "Warrant" as used herein shall include this Warrant and any warrants delivered in substitution or exchange therefor as provided herein. This Warrant was issued in connection with that certain Purchase Agreement dated MAY 20, 2010 by and between the Company and the Holder (as amended from time to time and in effect, the "Purchase Agreement"). The Company shall register this Warrant in the Company's books and records.

1. Term of Warrant and Exercise. Subject to the terms and conditions set forth herein and the Purchase Agreement, this Warrant shall be exercisable, at any time or from time to time, in whole or in part, at the sole option of the Holder, without any obligation to do so, during the term commencing the date this Warrant was issued and dated above, and ending at 5:00 p.m. on the date that is the twentieth anniversary date of the date of this Warrant (the

"Warrant Term"). The exercise price at which this Warrant may be exercised shall be $0.001 per Common Unit up to a maximum aggregate price of $100 (the "Exercise Price").

2. Exercise of Warrant.

2.1 Subject to the terms of this Warrant and the Purchase Agreement, the purchase rights represented by this Warrant are exercisable in whole or in part by the Holder, solely at the discretion of the Holder, during the Warrant Term by surrender of this Warrant and the attached Notice of Exercise, duly completed and executed on behalf of the Holder, at the principal office of the Company, upon payment of the Exercise Price in the form of (i) cash or by certified check to the Company, (ii) cancellation by the Holder of indebtedness of the Company to the Holder, or (iii) by a combination of (i) and (ii) above, it being the intent of the parties that the total value to the Company, through cash or forgiveness of indebtedness, equal the Exercise Price.

2.2 This Warrant shall be deemed to have been exercised immediately prior to the close of business on the date of its surrender for exercise as provided above, and the person entitled to receive the Common Units issuable upon such exercise shall be treated for all purposes as the holder of record of such Common Units as of the close of business on such date. As promptly as practicable on or after such date and in any event within ten (10) days thereafter, the Company at its expense shall issue and deliver to the person or persons entitled to receive the same a certificate or certificates for the number of Common Units issuable upon such exercise. In the event that this Warrant is exercised in part, the Company at its expense will execute and deliver a new Warrant of like tenor exercisable for the number of Common Units for which this Warrant may then be exercised.

3. Covenants. The Company covenants that Common Units that may be issued upon the exercise of rights represented by this Warrant, upon exercise of the rights represented by this Warrant and payment of the Exercise Price, all as set forth herein, will be duly authorized, validly issued, fully paid and non-assessable and free from all taxes, liens and charges in respect of the issue thereof.

4 Expenses from Issuance and Exercise. The Company shall pay all expenses and taxes imposed by law or any governmental agency, including any documentary stamp taxes, directly resulting from the issuance of Common Units upon the exercise of the Warrant.

5. Redemption. This Warrant and/or the Common Units issued in connection with an exercise of this Warrant are redeemable as set forth in the Purchase Agreement.

6. Amendments and Waivers. Any term of this Warrant may be amended and the observance of any term of this Warrant may be waived (either generally or in a particular instance and either retroactively or prospectively), only with the written consent of both the Company and the Holder. Any such amendment or waiver shall be binding on the parties.

7. Severability. If one or more provisions of this Warrant are held to be unenforceable under applicable law, such provision shall be excluded from this Warrant and the

balance of this Warrant shall be interpreted as if such provision were so excluded and shall be enforceable in accordance with its terms.

8. Governing Law. The terms and conditions of this Warrant shall be governed by and construed in accordance with the laws of the State of Illinois without regard to such State's choice of law provisions.

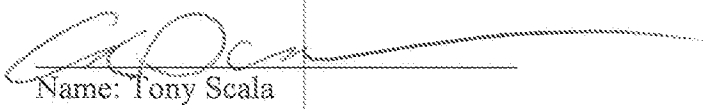
9. Titles and Subtitles. The titles and subtitles used in this Warrant are used for convenience only and are not to be considered in construing or interpreting this Warrant.

10. Notices. Unless otherwise provided, any notice required or permitted under this Warrant shall be given in writing and shall be delivered as set forth in the Purchase Agreement.

11. Lost Warrants. The Company represents and warrants to the Holder hereof that upon receipt of evidence reasonably satisfactory to the Company of the loss, theft, destruction, or mutilation of this Warrant and, in the case of any such loss, theft or destruction, upon receipt of an affidavit and indemnity by the Holder reasonably satisfactory to the Company, or in the case of any such mutilation upon surrender and cancellation of such Warrant, the Company, at its expense, will make and deliver a new Warrant, of like tenor, in lieu of the lost, stolen, destroyed or mutilated Warrant.

IN WITNESS WHEREOF, the Company has caused this Warrant to be duly executed as of September 17, 2010.

METROM, LLC, an Illinois limited liability company

By: 

Name: Tony Scala
Title: Manager

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NOTICE OF EXERCISE

To: **METROM, LLC**

Attn:

The undersigned hereby elects to purchase _____ percent (____%) of the Common Units of **METROM, LLC**, an Illinois limited liability company (the "Company"), at an Exercise Price as set forth in Section 1 of that certain Warrant for the Purchase of Common Units dated _____ __, 20__ (the "Warrant").

The undersigned requests that the Company issue the Common Units in the name of the undersigned or in such other name as is specified below:

_____
(Print Name)

By its signature below, the undersigned hereby confirms and acknowledges that the Common Units issuable upon exercise of the Warrant are being acquired solely for the account of the undersigned and not as a nominee for any other party, and for investment.

Date: _____

Very truly yours,

_____
(Print Name)

_____
(Signature)

By: _____
(Name and title of signatory, if non-natural person)

THIS NOTE WAS ISSUED IN A PRIVATE PLACEMENT, WITHOUT REGISTRATION UNDER THE SECURITIES ACT OF 1933, AS AMENDED (THE "ACT"), OR THE SECURITIES LAWS OF ANY STATE AND MAY NOT BE SOLD, TRANSFERRED, ASSIGNED, PLEDGED OR OTHERWISE DISPOSED OF IN THE ABSENCE OF AN EFFECTIVE REGISTRATION STATEMENT UNDER THE ACT AND ANY APPLICABLE STATE SECURITIES LAWS COVERING THE TRANSFER, OR THE DELIVERY TO THE BORROWER OF AN OPINION OF COUNSEL, REASONABLY SATISFACTORY TO THE BORROWER THAT SUCH REGISTRATION IS NOT REQUIRED.

PROMISSORY NOTE

U.S. $250,000 October 21, 2010

1. Principal Amount. For Value Received, Metrom, LLC, an Illinois limited liability company ("BORROWER"), promises to pay to RALPH EDWARD RYBACKI ("INVESTOR"), the total principal amount of TWO-HUNDRED FIFTY-THOUSAND DOLLARS ($250,000), on or before the date that is the fourth anniversary date of the date this Note (defined in Section 2 below) was issued (the "Maturity Date"), together with interest thereon at the rate or rates described below, and any and all other amounts which may be due and payable hereunder.

2. Interest. Simple interest shall accrue on the principal balance of this promissory note (this "Note") outstanding from the date hereof through the Maturity Date at an annual rate of interest equal to eleven percent (11.0%). Interest on this Note shall be calculated on the basis of a 360 day year of twelve 30-day months, and shall be payable quarterly on the first day of each January, April, July and October. In computing such interest, the date of this Note shall be included and the date of payment shall be excluded. After the Maturity Date or earlier acceleration of this Note, interest shall accrue on the outstanding principal balance at an annual rate of interest equal to fifteen percent (15%).

3. Payments. BORROWER is not obligated to make payments toward the reduction of the principal balance of this Note until the Maturity Date or upon the earlier acceleration of this Note. BORROWER, without notice, premium or penalty, may prepay this Note in whole or in part.

4. Events of Default. The occurrence of any one or more of the following events shall constitute an event of default ("Event of Default") under this Note:

(a) Payment Default. BORROWER shall fail to pay any principal or interest of this Note when due, whether at maturity, by acceleration or otherwise, and such failure shall continue for ten (10) days after the date due.

(b) Breach of Representation or Warranty. A material breach of a representation or warranty contained in that certain Purchase Agreement between BORROWER and INVESTOR dated MAY 20, 2010, as amended from time to time, providing for the issuance of this Note (the "Purchase Agreement").

(c) Breach of Covenant. BORROWER shall breach or fail to observe any covenant contained herein or the Purchase Agreement between BORROWER and INVESTOR, and such failure shall continue for thirty (30) days.

(d) Bankruptcy, Etc. BORROWER becomes insolvent or generally fails to pay its debts as they mature; or BORROWER applies for, consents to or acquiesces in the appointment of a trustee in bankruptcy, receiver or other custodian for BORROWER or any of its property or assets, or BORROWER makes a general assignment for the benefit of its creditors; or, in the absence of such application, consent or acquiescence, a trustee, receiver or other custodian is appointed for BORROWER or for a substantial part of its property or assets and such appointment is not discharged within sixty (60) days thereafter; or any bankruptcy, reorganization, debt arrangement or other case or proceeding under any bankruptcy or insolvency law, or any liquidation proceeding is commenced in respect of BORROWER and, if such case or proceeding is not commenced by BORROWER, it is either (i) consented to or acquiesced in by BORROWER, or (ii) remains un-dismissed for sixty (60) days.

5. Remedies. At the election of INVESTOR, the principal balance remaining unpaid under this Note, and all unpaid interest accrued thereon and any other amounts due hereunder, shall be and become immediately due and payable in full upon the occurrence of any Event of Default. Failure to exercise this option shall not constitute a waiver of the right to exercise same in the event of any subsequent Event of Default. INVESTOR shall not, by any act of omission or commission, be deemed to waive any of its rights, remedies or powers hereunder or otherwise unless such waiver is in writing and signed by INVESTOR, and then only to the extent specifically set forth therein. If any suit or action is instituted or attorneys are employed to collect this Note or any part hereof, BORROWER promises and agrees to pay all costs of collection, including reasonable attorneys' fees and court costs. The Borrower hereby waives presentment and demand for payment, notices of nonpayment and of dishonor, protest of dishonor, and notice of protest. Time is of the essence hereof.

6. Amendments; Waivers. This Note may not be modified except by written agreement signed by BORROWER and INVESTOR, and no provision hereof or breach thereof may be waived except in writing. The waiver of any term hereof or the breach thereof in any instance shall not be deemed to be a waiver of such term or breach in any other instance or of any other term or breach.

7. Governing Law. This Note is made under and governed in all respects by the laws of the State of Illinois (without regard to the conflicts of law principles thereof).

8. Venue and Jury Trial Waiver. BORROWER consents to the exclusive jurisdiction of the State and Federal Courts in the City of Chicago, State of Illinois, in the case of any dispute, claim, or controversy arising hereunder in any such proceeding, both INVESTOR and BORROWER shall each waive their rights to a trial by jury.

IN WITNESS WHEREOF, BORROWER has executed and delivered this Note as of the date first above written.

METROM, LLC, an Illinois limited liability company

By: _____
Name: Tony Scala
Title: Manager

THE WARRANT REPRESENTED HEREBY WAS ISSUED IN A PRIVATE PLACEMENT, WITHOUT REGISTRATION UNDER THE SECURITIES ACT OF 1933, AS AMENDED (THE "ACT"), OR THE SECURITIES LAWS OF ANY STATE AND MAY NOT BE SOLD, TRANSFERRED, ASSIGNED, PLEDGED OR OTHERWISE DISPOSED OF IN THE ABSENCE OF AN EFFECTIVE REGISTRATION STATEMENT UNDER THE ACT AND ANY APPLICABLE STATE SECURITIES LAWS COVERING THE TRANSFER, OR THE DELIVERY TO THE COMPANY OF AN OPINION OF COUNSEL, REASONABLY SATISFACTORY TO THE COMPANY, THAT SUCH REGISTRATION IS NOT REQUIRED.

UPON THE EXERCISE OF THIS WARRANT, THE COMMON UNITS WILL ALSO BE SUBJECT TO THE TERMS AND CONDITIONS OF AN OPERATING AGREEMENT BY AND AMONG THE COMPANY AND ITS MEMBERS, AS AMENDED FROM TIME TO TIME, A COPY OF WHICH AGREEMENT IS ON FILE AT THE PRINCIPAL OFFICE OF THE COMPANY. THE SALE, TRANSFER, ASSIGNMENT OR OTHER DISPOSITION OF THE SECURITIES IS SUBJECT TO THE TERMS AND CONDITIONS OF SUCH OPERATING AGREEMENT AND THE SECURITIES ARE TRANSFERABLE OR OTHERWISE DISPOSABLE ONLY UPON PROOF OF COMPLIANCE THEREWITH.

METROM, LLC, AN ILLINOIS LIMITED LIABILITY COMPANY

WARRANT TO PURCHASE COMMON UNITS

October 21, 2010

Void on the Twentieth Anniversary Date of the Date This Warrant is Issued

THIS CERTIFIES THAT, for value received, **RALPH EDWARD RYBACKI** (the "Holder"), is entitled to subscribe for and purchase from **METROM, LLC**, an Illinois limited liability company (the "Company") up to FOUR and ONE HUNDRED TWENTY FIVE THOUSANDTHS percent (4.125%) of the fully-diluted equity of the Company (which are currently represented by the Company's Common Units, the "Common Units") of the Company, upon surrender hereof, at the principal office of the Company, with the subscription form attached hereto duly executed, and simultaneous payment therefor as hereinafter provided, at the Exercise Price as set forth herein. The term "Warrant" as used herein shall include this Warrant and any warrants delivered in substitution or exchange therefor as provided herein. This Warrant was issued in connection with that certain Purchase Agreement dated MAY 20, 2010 by and between the Company and the Holder (as amended from time to time and in effect, the "Purchase Agreement"). The Company shall register this Warrant in the Company's books and records.

1. Term of Warrant and Exercise. Subject to the terms and conditions set forth herein and the Purchase Agreement, this Warrant shall be exercisable, at any time or from time to time, in whole or in part, at the sole option of the Holder, without any obligation to do so, during the term commencing the date this Warrant was issued and dated above, and ending at 5:00 p.m. on the date that is the twentieth anniversary date of the date of this Warrant (the

"Warrant Term"). The exercise price at which this Warrant may be exercised shall be $0.001 per Common Unit up to a maximum aggregate price of $100 (the "Exercise Price").

2. Exercise of Warrant.

2.1 Subject to the terms of this Warrant and the Purchase Agreement, the purchase rights represented by this Warrant are exercisable in whole or in part by the Holder, solely at the discretion of the Holder, during the Warrant Term by surrender of this Warrant and the attached Notice of Exercise, duly completed and executed on behalf of the Holder, at the principal office of the Company, upon payment of the Exercise Price in the form of (i) cash or by certified check to the Company, (ii) cancellation by the Holder of indebtedness of the Company to the Holder, or (iii) by a combination of (i) and (ii) above, it being the intent of the parties that the total value to the Company, through cash or forgiveness of indebtedness, equal the Exercise Price.

2.2 This Warrant shall be deemed to have been exercised immediately prior to the close of business on the date of its surrender for exercise as provided above, and the person entitled to receive the Common Units issuable upon such exercise shall be treated for all purposes as the holder of record of such Common Units as of the close of business on such date. As promptly as practicable on or after such date and in any event within ten (10) days thereafter, the Company at its expense shall issue and deliver to the person or persons entitled to receive the same a certificate or certificates for the number of Common Units issuable upon such exercise. In the event that this Warrant is exercised in part, the Company at its expense will execute and deliver a new Warrant of like tenor exercisable for the number of Common Units for which this Warrant may then be exercised.

3. Covenants. The Company covenants that Common Units that may be issued upon the exercise of rights represented by this Warrant, upon exercise of the rights represented by this Warrant and payment of the Exercise Price, all as set forth herein, will be duly authorized, validly issued, fully paid and non-assessable and free from all taxes, liens and charges in respect of the issue thereof.

4 Expenses from Issuance and Exercise. The Company shall pay all expenses and taxes imposed by law or any governmental agency, including any documentary stamp taxes, directly resulting from the issuance of Common Units upon the exercise of the Warrant.

5. Redemption. This Warrant and/or the Common Units issued in connection with an exercise of this Warrant are redeemable as set forth in the Purchase Agreement.

6. Amendments and Waivers. Any term of this Warrant may be amended and the observance of any term of this Warrant may be waived (either generally or in a particular instance and either retroactively or prospectively), only with the written consent of both the Company and the Holder. Any such amendment or waiver shall be binding on the parties.

7. Severability. If one or more provisions of this Warrant are held to be unenforceable under applicable law, such provision shall be excluded from this Warrant and the

balance of this Warrant shall be interpreted as if such provision were so excluded and shall be enforceable in accordance with its terms.

8. Governing Law. The terms and conditions of this Warrant shall be governed by and construed in accordance with the laws of the State of Illinois without regard to such State's choice of law provisions.

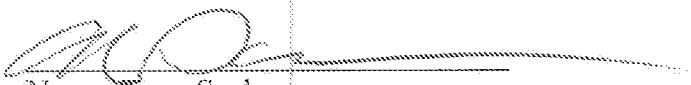
9. Titles and Subtitles. The titles and subtitles used in this Warrant are used for convenience only and are not to be considered in construing or interpreting this Warrant.

10. Notices. Unless otherwise provided, any notice required or permitted under this Warrant shall be given in writing and shall be delivered as set forth in the Purchase Agreement.

11. Lost Warrants. The Company represents and warrants to the Holder hereof that upon receipt of evidence reasonably satisfactory to the Company of the loss, theft, destruction, or mutilation of this Warrant and, in the case of any such loss, theft or destruction, upon receipt of an affidavit and indemnity by the Holder reasonably satisfactory to the Company, or in the case of any such mutilation upon surrender and cancellation of such Warrant, the Company, at its expense, will make and deliver a new Warrant, of like tenor, in lieu of the lost, stolen, destroyed or mutilated Warrant.

IN WITNESS WHEREOF, the Company has caused this Warrant to be duly executed as of October 2[illegible], 2010.

METROM, LLC, an Illinois limited liability company

By: 

Name: Tony Scala
Title: Manager

NOTICE OF EXERCISE

To: **METROM, LLC**

Attn:

The undersigned hereby elects to purchase _____ percent (____%) of the Common Units of **METROM, LLC**, an Illinois limited liability company (the "Company"), at an Exercise Price as set forth in Section 1 of that certain Warrant for the Purchase of Common Units dated _____ __, 20__ (the "Warrant").

The undersigned requests that the Company issue the Common Units in the name of the undersigned or in such other name as is specified below:

_____
(Print Name)

By its signature below, the undersigned hereby confirms and acknowledges that the Common Units issuable upon exercise of the Warrant are being acquired solely for the account of the undersigned and not as a nominee for any other party, and for investment.

Date: _____

Very truly yours,

_____
(Print Name)

_____
(Signature)

By: _____
(Name and title of signatory, if non-natural person)

THIS NOTE WAS ISSUED IN A PRIVATE PLACEMENT, WITHOUT REGISTRATION UNDER THE SECURITIES ACT OF 1933, AS AMENDED (THE "ACT"), OR THE SECURITIES LAWS OF ANY STATE AND MAY NOT BE SOLD, TRANSFERRED, ASSIGNED, PLEDGED OR OTHERWISE DISPOSED OF IN THE ABSENCE OF AN EFFECTIVE REGISTRATION STATEMENT UNDER THE ACT AND ANY APPLICABLE STATE SECURITIES LAWS COVERING THE TRANSFER, OR THE DELIVERY TO THE BORROWER OF AN OPINION OF COUNSEL, REASONABLY SATISFACTORY TO THE BORROWER THAT SUCH REGISTRATION IS NOT REQUIRED.

PROMISSORY NOTE

U.S. $250,000 December 8, 2010

1. Principal Amount. For Value Received, Metrom, LLC, an Illinois limited liability company ("BORROWER"), promises to pay to RALPH EDWARD RYBACKI ("INVESTOR"), the total principal amount of _TWO-HUNDRED FIFTY-THOUSAND DOLLARS ($250,000), on or before the date that is the fourth anniversary date of the date this Note (defined in Section 2 below) was issued (the "Maturity Date"), together with interest thereon at the rate or rates described below, and any and all other amounts which may be due and payable hereunder.

2. Interest. Simple interest shall accrue on the principal balance of this promissory note (this "Note") outstanding from the date hereof through the Maturity Date at an annual rate of interest equal to eleven percent (11.0%). Interest on this Note shall be calculated on the basis of a 360 day year of twelve 30-day months, and shall be payable quarterly on the first day of each January, April, July and October. In computing such interest, the date of this Note shall be included and the date of payment shall be excluded. After the Maturity Date or earlier acceleration of this Note, interest shall accrue on the outstanding principal balance at an annual rate of interest equal to fifteen percent (15%).

3. Payments. BORROWER is not obligated to make payments toward the reduction of the principal balance of this Note until the Maturity Date or upon the earlier acceleration of this Note. BORROWER, without notice, premium or penalty, may prepay this Note in whole or in part.

4. Events of Default. The occurrence of any one or more of the following events shall constitute an event of default ("Event of Default") under this Note:

(a) Payment Default. BORROWER shall fail to pay any principal or interest of this Note when due, whether at maturity, by acceleration or otherwise, and such failure shall continue for ten (10) days after the date due.

(b) Breach of Representation or Warranty. A material breach of a representation or warranty contained in that certain Purchase Agreement between BORROWER and INVESTOR dated MAY 20, 2010, as amended from time to time, providing for the issuance of this Note (the "Purchase Agreement").

(c) Breach of Covenant. BORROWER shall breach or fail to observe any covenant contained herein or the Purchase Agreement between BORROWER and INVESTOR, and such failure shall continue for thirty (30) days.

(d) Bankruptcy, Etc. BORROWER becomes insolvent or generally fails to pay its debts as they mature; or BORROWER applies for, consents to or acquiesces in the appointment of a trustee in bankruptcy, receiver or other custodian for BORROWER or any of its property or assets, or BORROWER makes a general assignment for the benefit of its creditors; or, in the absence of such application, consent or acquiescence, a trustee, receiver or other custodian is appointed for BORROWER or for a substantial part of its property or assets and such appointment is not discharged within sixty (60) days thereafter; or any bankruptcy, reorganization, debt arrangement or other case or proceeding under any bankruptcy or insolvency law, or any liquidation proceeding is commenced in respect of BORROWER and, if such case or proceeding is not commenced by BORROWER, it is either (i) consented to or acquiesced in by BORROWER, or (ii) remains un-dismissed for sixty (60) days.

5. Remedies. At the election of INVESTOR, the principal balance remaining unpaid under this Note, and all unpaid interest accrued thereon and any other amounts due hereunder, shall be and become immediately due and payable in full upon the occurrence of any Event of Default. Failure to exercise this option shall not constitute a waiver of the right to exercise same in the event of any subsequent Event of Default. INVESTOR shall not, by any act of omission or commission, be deemed to waive any of its rights, remedies or powers hereunder or otherwise unless such waiver is in writing and signed by INVESTOR, and then only to the extent specifically set forth therein. If any suit or action is instituted or attorneys are employed to collect this Note or any part hereof, BORROWER promises and agrees to pay all costs of collection, including reasonable attorneys' fees and court costs. The Borrower hereby waives presentment and demand for payment, notices of nonpayment and of dishonor, protest of dishonor, and notice of protest. Time is of the essence hereof.

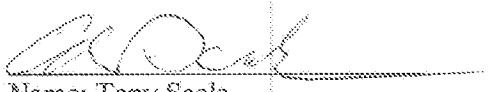
6. Amendments; Waivers. This Note may not be modified except by written agreement signed by BORROWER and INVESTOR, and no provision hereof or breach thereof may be waived except in writing. The waiver of any term hereof or the breach thereof in any instance shall not be deemed to be a waiver of such term or breach in any other instance or of any other term or breach.

7. Governing Law. This Note is made under and governed in all respects by the laws of the State of Illinois (without regard to the conflicts of law principles thereof).

8. Venue and Jury Trial Waiver. BORROWER consents to the exclusive jurisdiction of the State and Federal Courts in the City of Chicago, State of Illinois, in the case of any dispute, claim, or controversy arising hereunder in any such proceeding, both INVESTOR and BORROWER shall each waive their rights to a trial by jury.

IN WITNESS WHEREOF, BORROWER has executed and delivered this Note as of the date first above written.

METROM, LLC, an Illinois limited liability company

By: 

Name: Tony Scala
Title: Manager

THE WARRANT REPRESENTED HEREBY WAS ISSUED IN A PRIVATE PLACEMENT, WITHOUT REGISTRATION UNDER THE SECURITIES ACT OF 1933, AS AMENDED (THE "ACT"), OR THE SECURITIES LAWS OF ANY STATE AND MAY NOT BE SOLD, TRANSFERRED, ASSIGNED, PLEDGED OR OTHERWISE DISPOSED OF IN THE ABSENCE OF AN EFFECTIVE REGISTRATION STATEMENT UNDER THE ACT AND ANY APPLICABLE STATE SECURITIES LAWS COVERING THE TRANSFER, OR THE DELIVERY TO THE COMPANY OF AN OPINION OF COUNSEL, REASONABLY SATISFACTORY TO THE COMPANY, THAT SUCH REGISTRATION IS NOT REQUIRED.

UPON THE EXERCISE OF THIS WARRANT, THE COMMON UNITS WILL ALSO BE SUBJECT TO THE TERMS AND CONDITIONS OF AN OPERATING AGREEMENT BY AND AMONG THE COMPANY AND ITS MEMBERS, AS AMENDED FROM TIME TO TIME, A COPY OF WHICH AGREEMENT IS ON FILE AT THE PRINCIPAL OFFICE OF THE COMPANY. THE SALE, TRANSFER, ASSIGNMENT OR OTHER DISPOSITION OF THE SECURITIES IS SUBJECT TO THE TERMS AND CONDITIONS OF SUCH OPERATING AGREEMENT AND THE SECURITIES ARE TRANSFERABLE OR OTHERWISE DISPOSABLE ONLY UPON PROOF OF COMPLIANCE THEREWITH.

METROM, LLC, AN ILLINOIS LIMITED LIABILITY COMPANY

WARRANT TO PURCHASE COMMON UNITS

December 8, 2010

Void on the Twentieth Anniversary Date of the Date This Warrant is Issued

THIS CERTIFIES THAT, for value received, **RALPH EDWARD RYBACKI** (the "Holder"), is entitled to subscribe for and purchase from **METROM, LLC**, an Illinois limited liability company (the "Company") up to FOUR and ONE HUNDRED TWENTY FIVE THOUSANDTHS percent (4.125%) of the fully-diluted equity of the Company (which are currently represented by the Company's Common Units, the "Common Units") of the Company, upon surrender hereof, at the principal office of the Company, with the subscription form attached hereto duly executed, and simultaneous payment therefor as hereinafter provided, at the Exercise Price as set forth herein. The term "Warrant" as used herein shall include this Warrant and any warrants delivered in substitution or exchange therefor as provided herein. This Warrant was issued in connection with that certain Purchase Agreement dated MAY 20, 2010 by and between the Company and the Holder (as amended from time to time and in effect, the "Purchase Agreement"). The Company shall register this Warrant in the Company's books and records.

1. Term of Warrant and Exercise. Subject to the terms and conditions set forth herein and the Purchase Agreement, this Warrant shall be exercisable, at any time or from time to time, in whole or in part, at the sole option of the Holder, without any obligation to do so, during the term commencing the date this Warrant was issued and dated above, and ending at 5:00 p.m. on the date that is the twentieth anniversary date of the date of this Warrant (the

"Warrant Term"). The exercise price at which this Warrant may be exercised shall be $0.001 per Common Unit up to a maximum aggregate price of $100 (the "Exercise Price").

2. Exercise of Warrant.

2.1 Subject to the terms of this Warrant and the Purchase Agreement, the purchase rights represented by this Warrant are exercisable in whole or in part by the Holder, solely at the discretion of the Holder, during the Warrant Term by surrender of this Warrant and the attached Notice of Exercise, duly completed and executed on behalf of the Holder, at the principal office of the Company, upon payment of the Exercise Price in the form of (i) cash or by certified check to the Company, (ii) cancellation by the Holder of indebtedness of the Company to the Holder, or (iii) by a combination of (i) and (ii) above, it being the intent of the parties that the total value to the Company, through cash or forgiveness of indebtedness, equal the Exercise Price.

2.2 This Warrant shall be deemed to have been exercised immediately prior to the close of business on the date of its surrender for exercise as provided above, and the person entitled to receive the Common Units issuable upon such exercise shall be treated for all purposes as the holder of record of such Common Units as of the close of business on such date. As promptly as practicable on or after such date and in any event within ten (10) days thereafter, the Company at its expense shall issue and deliver to the person or persons entitled to receive the same a certificate or certificates for the number of Common Units issuable upon such exercise. In the event that this Warrant is exercised in part, the Company at its expense will execute and deliver a new Warrant of like tenor exercisable for the number of Common Units for which this Warrant may then be exercised.

3. Covenants. The Company covenants that Common Units that may be issued upon the exercise of rights represented by this Warrant, upon exercise of the rights represented by this Warrant and payment of the Exercise Price, all as set forth herein, will be duly authorized, validly issued, fully paid and non-assessable and free from all taxes, liens and charges in respect of the issue thereof.

4 Expenses from Issuance and Exercise. The Company shall pay all expenses and taxes imposed by law or any governmental agency, including any documentary stamp taxes, directly resulting from the issuance of Common Units upon the exercise of the Warrant.

5. Redemption. This Warrant and/or the Common Units issued in connection with an exercise of this Warrant are redeemable as set forth in the Purchase Agreement.

6. Amendments and Waivers. Any term of this Warrant may be amended and the observance of any term of this Warrant may be waived (either generally or in a particular instance and either retroactively or prospectively), only with the written consent of both the Company and the Holder. Any such amendment or waiver shall be binding on the parties.

7. Severability. If one or more provisions of this Warrant are held to be unenforceable under applicable law, such provision shall be excluded from this Warrant and the

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balance of this Warrant shall be interpreted as if such provision were so excluded and shall be enforceable in accordance with its terms.

8. Governing Law. The terms and conditions of this Warrant shall be governed by and construed in accordance with the laws of the State of Illinois without regard to such State's choice of law provisions.

9. Titles and Subtitles. The titles and subtitles used in this Warrant are used for convenience only and are not to be considered in construing or interpreting this Warrant.

10. Notices. Unless otherwise provided, any notice required or permitted under this Warrant shall be given in writing and shall be delivered as set forth in the Purchase Agreement.

11. Lost Warrants. The Company represents and warrants to the Holder hereof that upon receipt of evidence reasonably satisfactory to the Company of the loss, theft, destruction, or mutilation of this Warrant and, in the case of any such loss, theft or destruction, upon receipt of an affidavit and indemnity by the Holder reasonably satisfactory to the Company, or in the case of any such mutilation upon surrender and cancellation of such Warrant, the Company, at its expense, will make and deliver a new Warrant, of like tenor, in lieu of the lost, stolen, destroyed or mutilated Warrant.

IN WITNESS WHEREOF, the Company has caused this Warrant to be duly executed as of December 8, 2010.

METROM, LLC, an Illinois limited liability company

By: _____
Name: Tony Scala
Title: Manager

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NOTICE OF EXERCISE

To: **METROM, LLC**

Attn:

The undersigned hereby elects to purchase _____ percent (____%) of the Common Units of **METROM, LLC**, an Illinois limited liability company (the "Company"), at an Exercise Price as set forth in Section 1 of that certain Warrant for the Purchase of Common Units dated _____ __, 20__ (the "Warrant").

The undersigned requests that the Company issue the Common Units in the name of the undersigned or in such other name as is specified below:

_____
(Print Name)

By its signature below, the undersigned hereby confirms and acknowledges that the Common Units issuable upon exercise of the Warrant are being acquired solely for the account of the undersigned and not as a nominee for any other party, and for investment.

Date: _____

Very truly yours,

_____
(Print Name)

_____
(Signature)

By: _____
(Name and title of signatory, if non-natural person)

THIS NOTE WAS ISSUED IN A PRIVATE PLACEMENT, WITHOUT REGISTRATION UNDER THE SECURITIES ACT OF 1933, AS AMENDED (THE "ACT"), OR THE SECURITIES LAWS OF ANY STATE AND MAY NOT BE SOLD, TRANSFERRED, ASSIGNED, PLEDGED OR OTHERWISE DISPOSED OF IN THE ABSENCE OF AN EFFECTIVE REGISTRATION STATEMENT UNDER THE ACT AND ANY APPLICABLE STATE SECURITIES LAWS COVERING THE TRANSFER, OR THE DELIVERY TO THE BORROWER OF AN OPINION OF COUNSEL, REASONABLY SATISFACTORY TO THE BORROWER THAT SUCH REGISTRATION IS NOT REQUIRED.

PROMISSORY NOTE

U.S. $250,000 February 4, 2011

1. Principal Amount. For Value Received, Metrom, LLC, an Illinois limited liability company ("BORROWER"), promises to pay to RALPH EDWARD RYBACKI ("INVESTOR"), the total principal amount of _TWO-HUNDRED FIFTY-THOUSAND DOLLARS ($250,000), on or before the date that is the fourth anniversary date of the date this Note (defined in Section 2 below) was issued (the "Maturity Date"), together with interest thereon at the rate or rates described below, and any and all other amounts which may be due and payable hereunder.

2. Interest. Simple interest shall accrue on the principal balance of this promissory note (this "Note") outstanding from the date hereof through the Maturity Date at an annual rate of interest equal to eleven percent (11.0%). Interest on this Note shall be calculated on the basis of a 360 day year of twelve 30-day months, and shall be payable quarterly on the first day of each January, April, July and October. In computing such interest, the date of this Note shall be included and the date of payment shall be excluded. After the Maturity Date or earlier acceleration of this Note, interest shall accrue on the outstanding principal balance at an annual rate of interest equal to fifteen percent (15%).

3. Payments. BORROWER is not obligated to make payments toward the reduction of the principal balance of this Note until the Maturity Date or upon the earlier acceleration of this Note. BORROWER, without notice, premium or penalty, may prepay this Note in whole or in part.

4. Events of Default. The occurrence of any one or more of the following events shall constitute an event of default ("Event of Default") under this Note:

(a) Payment Default. BORROWER shall fail to pay any principal or interest of this Note when due, whether at maturity, by acceleration or otherwise, and such failure shall continue for ten (10) days after the date due.

(b) Breach of Representation or Warranty. A material breach of a representation or warranty contained in that certain Purchase Agreement between BORROWER and INVESTOR dated MAY 20, 2010, as amended from time to time, providing for the issuance of this Note (the "Purchase Agreement").

(c) Breach of Covenant. BORROWER shall breach or fail to observe any covenant contained herein or the Purchase Agreement between BORROWER and INVESTOR, and such failure shall continue for thirty (30) days.

(d) Bankruptcy, Etc. BORROWER becomes insolvent or generally fails to pay its debts as they mature; or BORROWER applies for, consents to or acquiesces in the appointment of a trustee in bankruptcy, receiver or other custodian for BORROWER or any of its property or assets, or BORROWER makes a general assignment for the benefit of its creditors; or, in the absence of such application, consent or acquiescence, a trustee, receiver or other custodian is appointed for BORROWER or for a substantial part of its property or assets and such appointment is not discharged within sixty (60) days thereafter; or any bankruptcy, reorganization, debt arrangement or other case or proceeding under any bankruptcy or insolvency law, or any liquidation proceeding is commenced in respect of BORROWER and, if such case or proceeding is not commenced by BORROWER, it is either (i) consented to or acquiesced in by BORROWER, or (ii) remains un-dismissed for sixty (60) days.

5. Remedies. At the election of INVESTOR, the principal balance remaining unpaid under this Note, and all unpaid interest accrued thereon and any other amounts due hereunder, shall be and become immediately due and payable in full upon the occurrence of any Event of Default. Failure to exercise this option shall not constitute a waiver of the right to exercise same in the event of any subsequent Event of Default. INVESTOR shall not, by any act of omission or commission, be deemed to waive any of its rights, remedies or powers hereunder or otherwise unless such waiver is in writing and signed by INVESTOR, and then only to the extent specifically set forth therein. If any suit or action is instituted or attorneys are employed to collect this Note or any part hereof, BORROWER promises and agrees to pay all costs of collection, including reasonable attorneys' fees and court costs. The Borrower hereby waives presentment and demand for payment, notices of nonpayment and of dishonor, protest of dishonor, and notice of protest. Time is of the essence hereof.

6. Amendments; Waivers. This Note may not be modified except by written agreement signed by BORROWER and INVESTOR, and no provision hereof or breach thereof may be waived except in writing. The waiver of any term hereof or the breach thereof in any instance shall not be deemed to be a waiver of such term or breach in any other instance or of any other term or breach.

7. Governing Law. This Note is made under and governed in all respects by the laws of the State of Illinois (without regard to the conflicts of law principles thereof).

8. Venue and Jury Trial Waiver. BORROWER consents to the exclusive jurisdiction of the State and Federal Courts in the City of Chicago, State of Illinois, in the case of any dispute, claim, or controversy arising hereunder in any such proceeding, both INVESTOR and BORROWER shall each waive their rights to a trial by jury.

IN WITNESS WHEREOF, BORROWER has executed and delivered this Note as of the date first above written.

METROM, LLC, an Illinois limited liability company

By: _____
Name: Tony Scala
Title: Manager

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METROM, LLC, AN ILLINOIS LIMITED LIABILITY COMPANY

WARRANT TO PURCHASE COMMON UNITS

February 4, 2011

Void on the Twentieth Anniversary Date of the Date This Warrant is Issued

THIS CERTIFIES THAT, for value received, **RALPH EDWARD RYBACKI** (the "Holder"), is entitled to subscribe for and purchase from **METROM, LLC**, an Illinois limited liability company (the "Company") up to FOUR and ONE HUNDRED TWENTY FIVE THOUSANDTHS percent (4.125%) of the fully-diluted equity of the Company (which are currently represented by the Company's Common Units, the "Common Units") of the Company, upon surrender hereof, at the principal office of the Company, with the subscription form attached hereto duly executed, and simultaneous payment therefor as hereinafter provided, at the Exercise Price as set forth herein. The term "Warrant" as used herein shall include this Warrant and any warrants delivered in substitution or exchange therefor as provided herein. This Warrant was issued in connection with that certain Purchase Agreement dated MAY 20, 2010 by and between the Company and the Holder (as amended from time to time and in effect, the "Purchase Agreement"). The Company shall register this Warrant in the Company's books and records.

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"Warrant Term"). The exercise price at which this Warrant may be exercised shall be $0.001 per Common Unit up to a maximum aggregate price of $100 (the "Exercise Price").

2. Exercise of Warrant.

2.1 Subject to the terms of this Warrant and the Purchase Agreement, the purchase rights represented by this Warrant are exercisable in whole or in part by the Holder, solely at the discretion of the Holder, during the Warrant Term by surrender of this Warrant and the attached Notice of Exercise, duly completed and executed on behalf of the Holder, at the principal office of the Company, upon payment of the Exercise Price in the form of (i) cash or by certified check to the Company, (ii) cancellation by the Holder of indebtedness of the Company to the Holder, or (iii) by a combination of (i) and (ii) above, it being the intent of the parties that the total value to the Company, through cash or forgiveness of indebtedness, equal the Exercise Price.

2.2 This Warrant shall be deemed to have been exercised immediately prior to the close of business on the date of its surrender for exercise as provided above, and the person entitled to receive the Common Units issuable upon such exercise shall be treated for all purposes as the holder of record of such Common Units as of the close of business on such date. As promptly as practicable on or after such date and in any event within ten (10) days thereafter, the Company at its expense shall issue and deliver to the person or persons entitled to receive the same a certificate or certificates for the number of Common Units issuable upon such exercise. In the event that this Warrant is exercised in part, the Company at its expense will execute and deliver a new Warrant of like tenor exercisable for the number of Common Units for which this Warrant may then be exercised.

3. Covenants. The Company covenants that Common Units that may be issued upon the exercise of rights represented by this Warrant, upon exercise of the rights represented by this Warrant and payment of the Exercise Price, all as set forth herein, will be duly authorized, validly issued, fully paid and non-assessable and free from all taxes, liens and charges in respect of the issue thereof.

4 Expenses from Issuance and Exercise. The Company shall pay all expenses and taxes imposed by law or any governmental agency, including any documentary stamp taxes, directly resulting from the issuance of Common Units upon the exercise of the Warrant.

5. Redemption. This Warrant and/or the Common Units issued in connection with an exercise of this Warrant are redeemable as set forth in the Purchase Agreement.

6. Amendments and Waivers. Any term of this Warrant may be amended and the observance of any term of this Warrant may be waived (either generally or in a particular instance and either retroactively or prospectively), only with the written consent of both the Company and the Holder. Any such amendment or waiver shall be binding on the parties.

7. Severability. If one or more provisions of this Warrant are held to be unenforceable under applicable law, such provision shall be excluded from this Warrant and the

balance of this Warrant shall be interpreted as if such provision were so excluded and shall be enforceable in accordance with its terms.

8. Governing Law. The terms and conditions of this Warrant shall be governed by and construed in accordance with the laws of the State of Illinois without regard to such State's choice of law provisions.

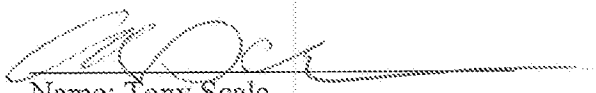
9. Titles and Subtitles. The titles and subtitles used in this Warrant are used for convenience only and are not to be considered in construing or interpreting this Warrant.

10. Notices. Unless otherwise provided, any notice required or permitted under this Warrant shall be given in writing and shall be delivered as set forth in the Purchase Agreement.

11. Lost Warrants. The Company represents and warrants to the Holder hereof that upon receipt of evidence reasonably satisfactory to the Company of the loss, theft, destruction, or mutilation of this Warrant and, in the case of any such loss, theft or destruction, upon receipt of an affidavit and indemnity by the Holder reasonably satisfactory to the Company, or in the case of any such mutilation upon surrender and cancellation of such Warrant, the Company, at its expense, will make and deliver a new Warrant, of like tenor, in lieu of the lost, stolen, destroyed or mutilated Warrant.

IN WITNESS WHEREOF, the Company has caused this Warrant to be duly executed as of February 4, 2011.

METROM, LLC, an Illinois limited liability company

By: 

Name: Tony Scala
Title: Manager

NOTICE OF EXERCISE

To: **METROM, LLC**

Attn:

The undersigned hereby elects to purchase _____ percent (____%) of the Common Units of **METROM, LLC**, an Illinois limited liability company (the "Company"), at an Exercise Price as set forth in Section 1 of that certain Warrant for the Purchase of Common Units dated _____ __, 20__ (the "Warrant").

The undersigned requests that the Company issue the Common Units in the name of the undersigned or in such other name as is specified below:

_____
(Print Name)

By its signature below, the undersigned hereby confirms and acknowledges that the Common Units issuable upon exercise of the Warrant are being acquired solely for the account of the undersigned and not as a nominee for any other party, and for investment.

Date: _____

Very truly yours,

_____
(Print Name)

_____
(Signature)

By: _____
(Name and title of signatory, if non-natural person)

METROM RAIL

www.metrom-rail.com

220 Telser Road
Lake Zurich, IL 60047
847-847-7233

Bridge Funding Agreement

In exchange for Bridge Financing to be provided by Ralph Rybacki in the amount of $250,000 to be wire transferred to Metrom Rail, LLC (FEIN [redacted] no later than June 17, 2011, Metrom Rail, LLC agrees to provide the following:

1. One and one half percent (1.5%) of the Common, Fully Diluted Equity of the company.
2. Interest at the rate of fifteen percent (15%) per annum to be accrued until principal is paid back. Interest will be paid concurrent with repayment of principal.
3. Principal is to be paid back by August 15, 2011.
4. If principal is not paid back at that date, Metrom Rail, LLC will be provided the opportunity to cure until 11:59 PM on August 29th, 2011. Either Ralph Rybacki or his designated agent promises to be available to receive the principal payback until that time.
5. If Metrom Rail, LLC does not cure as per #4 above by the designated date and time, then Ralph Rybacki will receive an additional one and one half percent (1.5%) of the Common, Fully Diluted Equity of Metrom Rail, LLC, bringing his total amount owned at that time to three percent (3.0%).
6. Wire transfer information for Metrom Rail, LLC is attached to this document.

Agreed to and understood by:

Tony Scala
Managing Member, Metrom Rail, LLC

Ralph Rybacki

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
(Attorney Docket No. 24983US02)

In the Application of:

Richard C. Carlson

Serial No.: 13/474,428

Filed: May 17, 2012

For: COLLISION AVOIDANCE SYSTEM FOR RAIL LINE VEHICLES

Examiner: Robert T. Payne

Group Art Unit: 3662

Confirmation No. 6724

Certificate Of Transmission

I hereby certify that this correspondence is being transmitted via EFS-Web to the United States Patent and Trademark Office on December 2, 2013.

/Michael J. Krautner/
Michael J. Krautner
Reg. No. 59,218

AMENDMENT AND RESPONSE TO NON-FINAL OFFICE ACTION

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Examiner Payne:

Applicants submit this amendment and response to the communication from the Patent Office dated August 2, 2013 ("the Office Action"). This response is submitted on or December 2, 2013, along with a petition for a one month extension of time and the associated fee. Please enter and consider the following.

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1-24. (Cancelled)

25. (New) A collision avoidance system comprising:

– one or more vehicle mounted modules, each vehicle mounted module mountable on a rail vehicle, each vehicle mounted module comprising:

– a transponder sensor module operable to send and receive data wirelessly, the transponder module comprising a first ultra wideband unit and a first antenna;

– a control electronics module comprising a processor in communication with at least the transponder sensor module unit; and

– a user interface module including a user interface, the user interface being operable to provide rail vehicle information to a vehicle operator and to receive input from the vehicle operator; and

wherein each vehicle mounted module is operable to communicate with at least one other vehicle mounted module mounted on at least one other rail vehicle, and wherein each vehicle mounted module is operable to apply a time of flight technique to determine a separation distance between the rail vehicles.

26. (New) The collision avoidance system of claim 25, further comprising a central tracking unit in communication with the first vehicle mounted module and the second vehicle mounted module, wherein the central tracking unit is operable to track the location of at least the first vehicle mounted module and the second vehicle mounted module.

27. (New) The collision avoidance system of claim 26, wherein the central tracking unit is distributed among a plurality of rail vehicles, including at least the first and second rail vehicles, wherein the first vehicle mounted module comprises a first central tracking unit component.

28. (New) The collision avoidance system of claim 26, wherein the central tracking unit is located in a discreet housing.

29. (New) The collision avoidance system of claim 25, wherein the first vehicle mounted module further comprises an auxiliary transponder sensor module, the auxiliary transponder sensor module mounted on the first rail vehicle with an offset with respect to the transponder sensor module, and

wherein the user interface is operable to provide calibration information related to the length of the first rail vehicle, the mounting location of the first transponder sensor module, and the mounting location of the auxiliary transponder sensor module.

30. (New) The collision avoidance system of claim 29, wherein the auxiliary transponder sensor module comprises an auxiliary antenna, the auxiliary antenna being connected to at least one of the first ultra wideband unit or an auxiliary ultra wideband unit, and

wherein the auxiliary antenna is mounted on the first rail vehicle with an offset with respect to the first antenna.

31. (New) The collision avoidance system of claim 25, wherein the first vehicle mounted module further comprises a global positioning system unit, the global positioning system unit operable to receive information from one or more satellites to determine an absolute position of the rail vehicle, wherein the global positioning system unit is in communication with the control electronics module.

32. (New) The collision avoidance system of claim 31, wherein the first vehicle mounted module receives information generated by the global positioning system unit and the first ultra wideband unit to determine whether one or more vehicle separation criteria are violated, and generates a warning signal when one or more vehicle separation criteria are violated.

33. (New) The collision avoidance system of claim 25, wherein the first vehicle mounted module is operable to execute a progressive warning signal if one or more vehicle separation criteria are violated, and

wherein the progressive warning signal increases in at least one of signal rate, signal frequency, signal prominence, signal volume, or signal severity as the violation of the vehicle separation criteria approaches or extends beyond a vehicle separation threshold.

34. (New) The collision avoidance system of claim 34, wherein the first vehicle mounted module executes an adaptive threshold feature that modifies one or more vehicle separation thresholds based on the speed of the first rail vehicle and the speed of the second rail vehicle.

35. (New) The collision avoidance system of claim 25, further comprising at least one ground speed detection module operable to determine the speed of the rail vehicle, wherein the first vehicle mounted module communicates with the at least one ground speed detection module.

36. (New) The collision avoidance system of claim 25, further comprising an inertial measurement unit in communication with at least the control electronics module, the inertial measurement unit being operable to detect changes in the speed of the first rail vehicle.

37. (New) The collision avoidance system of claim 36, wherein the inertial measurement unit comprises at least one of an accelerometer or a gyroscope.

38. (New) The collision avoidance system of claim 25 wherein the ultra wideband unit is adapted to transmit and receive signals with varying center frequencies.

39. (New) The collision avoidance system of claim 25, wherein the first vehicle mounted module is operable to execute a stopping distance calibration feature that measures a stopping distance under existing conditions, wherein the stopping distance measures the distance between the point where the brakes are engaged to the point where the vehicle comes to a stop under the existing conditions.

40. (New) The collision avoidance system of claim 39, wherein the first vehicle mounted module executes a progressive warning signal if one or more vehicle separation criteria are violated,

wherein the progressive warning signal increases in at least one of signal rate, signal frequency, signal prominence, signal volume, or signal severity as the violation of the vehicle separation criteria approaches or extends beyond a vehicle separation threshold, and

wherein the first vehicle mounted module executes an adaptive threshold feature that modifies one or more vehicle separation thresholds based on the measured stopping distance.

41. (New) A rail vehicle module mountable on a rail vehicle, the module comprising:

- a transponder sensor module comprising:
  - a radio communication unit operable to employ time of flight techniques to detect a distance between the rail vehicle and at least one other vehicle;
  - a wireless communications antenna operable to send and receive data over the air; and
  - a global positioning system unit operable to receive information from one or more satellites to determine an absolute position of the rail vehicle;

– a control electronics module comprising a processor in communication with at least the first transponder sensor module; and

– a user interface module including a user interface operable to provide rail vehicle information to a vehicle operator and to receive input from the vehicle operator;

wherein the rail vehicle module communicates with at least one other module mounted on at least one other vehicle to detect a separation distance between the rail vehicle and the at least one other vehicle.

42. (New) The rail vehicle module of claim 41, wherein the radio communication unit comprises an ultra wideband unit configured to send and receive ultra wideband signals.

43. (New) The rail vehicle module of claim 42, wherein the ultra wideband unit is adapted to transmit and receive signals with varying center frequencies.

44. (New) The rail vehicle module of claim 41, further comprising a second wireless communications antenna mounted on the rail vehicle with an offset with respect to the first antenna,

wherein the rail vehicle module is operable to receive calibration information related to the length of the rail vehicle, the mounting location of the first wireless communications antenna and the mounting location of the second wireless communications antenna.

45. (New) The rail vehicle module of claim 41, wherein the rail vehicle module is operable to utilize information generated by the radio communication unit and the global positioning system unit to determine whether one or more vehicle separation criteria are violated, and generate a progressive warning signal if one or more vehicle separation criteria are violated,

wherein the progressive warning signal increases in at least one of signal rate, signal frequency, signal prominence, signal volume, or signal severity as the violation of the vehicle separation criteria approaches or extends beyond a vehicle separation threshold.

46. (New) The rail vehicle module of claim 41, further comprising a central tracking unit component, wherein the central tracking unit component is in communication with a central tracking unit component mounted on the at least one other vehicle.

47. (New) The collision avoidance system of claim 40, further comprising an inertial measurement unit in communication with at least the control electronics module, the inertial measurement unit being operable to detect changes in the speed of the first rail vehicle.

48. A collision avoidance system comprising

- one or more vehicle mounted modules, each vehicle mounted module mountable on a rail vehicle, each vehicle mounted module comprising:
  - a transponder sensor module comprising:
    - a radio communication unit operable to employ time of flight techniques to detect a distance between rail vehicles; and
    - a global positioning system unit operable to receive information from one or more satellites to determine an absolute position of the rail line vehicle;
  - a control electronics module comprising a processor, the control electronics module being in communication with at least the transponder sensor module; and
  - a user interface operable to provide rail vehicle information to a vehicle operator and to receive input from the vehicle operator;

wherein each of the two or more rail vehicle modules communicate to determine a separation distance between each rail vehicle, and wherein each rail vehicle module is operable to use information provided by the radio communication unit and the global positioning system unit to determine whether one or more vehicle separation criteria are violated, and to generate a warning signal if one or more vehicle separation criteria are violated.

49. (New) The collision avoidance system of claim 48, wherein each radio communication unit comprises an ultra wideband unit.

50. (New) The collision avoidance system of claim 48, wherein the progressive warning signal increases in at least one of signal rate, signal frequency, signal prominence, signal volume, or signal severity as the violation of the vehicle separation criteria approaches or extends beyond a vehicle separation threshold.

51. (New) The collision avoidance system of claim 48, further comprising a central tracking unit in communication with each rail vehicle module, the central tracking unit operable to track the location of each rail vehicle module.

52. (New) The collision avoidance system of claim 51, wherein the central tracking unit is distributed among the rail vehicle modules, wherein each of the one or more rail vehicle modules includes a central tracking unit component, each central tracking unit component being in communication with the control electronics module of the rail vehicle module.

REMARKS

The present application includes claims 25-52. The Office Action has rejected previously pending claims 1-24. By this Response, Applicants cancel claims 1-24 and add new claims 25-52.

The Office Action rejected previous claims 1-10, 13, and 17-24 under 35 USC § 102(b) as anticipated by US Patent Application Publication no. 2008/0150786 ("Breed").

The Office Action rejected previous claims 11-12 and 14 under 35 USC § 103(a) as obvious over Breed in view of US Patent Application Publication no. 2006/0025897 ("Shostak").

The Office Action rejected previous claims 15-16 under 35 USC § 103(a) in view of US Patent Application Publication no. 2010/0207787 ("Catten").

By this response, Applicants have cancelled the previously pending claims and added new claims for purposes of clarity. By this amendment, the present application now includes:

- independent claim 25 and dependent claims 26-40, which recite a collision avoidance system,
- independent claim 43 and dependent claims 41-47, which recite a rail vehicle module, and
- independent claim 48 and dependent claims 49-52, which recite a collision avoidance system.

The newly added claims recite rail vehicle modules, or collision avoidance systems that use vehicle mounted modules that communicate with one another and use time of flight techniques to determine a separation distance between rail vehicles.

Applicants respectfully submit that the present amendments are all fully supported by the specification, figures, and original claims of the present application as originally filed, and, therefore, do not constitute new matter.

Breed Does Not Anticipate The Independent Claims

The Office Action rejected original claim 20 under 35 USC 102(a) as anticipated by Breed. Applicant respectfully submits that Breed does not anticipate the claims of the present application, because Breed fails to teach many elements set forth in the claims. *See Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631 (Fed. Cir. 1987) ("A claim is anticipated ***only if each and every element*** as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." (emphasis added)).

Here, Breed fails to teach all of the elements recited by the currently pending claims. First, Breed does not teach a module that uses time of flight techniques, or communicates with a second module located on a second rail vehicle to determine a separation between the two vehicles. Second, Breed does not relate to rail line vehicles, an element recited in all of the currently pending claims.

Breed does not teach a modules communicating using time of flight techniques

By the present response, Applicant amends the independent claims to recite a module on a first rail line vehicle that communicates with a module on a second rail line vehicle using time of flight techniques. Specifically, independent claims 25 and 48 recite one or more vehicle mounted modules mountable on rail vehicles that communicate with one another, and determine a separation distance between the vehicles using time of flight techniques. Similarly, independent claim 41 recites a rail vehicle module mountable on a rail vehicle that can communicate with other rail vehicle modules mounted on other vehicles to determine separation distance using time of flight techniques.

The specification discloses time of flight techniques, for example, at paragraph [0064]. As disclosed in the specification, time of flight determines a distance between two signaling units by measuring the time it takes a signal to travel from one module to another, and back. Breed does not teach using time of flight techniques, nor does it teach determining a separation distance between rail vehicles. Because Breed does not teach this claimed technique, it cannot anticipate the present claims.

Moreover, the present claims all recite modules mounted or mountable on separate vehicles that are capable of communicating with one another. This claimed feature allows each vehicle to know the ***separation distance*** between itself and the vehicle immediately to its front, and/or the vehicle immediately to its rear. Because these modules are in communicate directly with each other, they do not require the positioning of fixed communication transmitters at fixed locations.

Because the modules can communicate directly with one another, the modules of the present technology can exchange information regardless of their location with respect to other stationary objects. That is, a rail line vehicle employing the presently claimed technology does not have to be within the range of a stationary transmitter or communication station in order to determine the separation distance between itself and the nearest rail line vehicles.

Breed does not teach modules that communicate with one another. As a result, a Breed vehicle traveling beyond the range of the one of various stationary transmitters (i.e., Breed transmitters 151, 152, and 153) that are located at a fixed position, Breed will be unable to determine the vehicle position, and therefore unable to determine a separation distance with respect to any other vehicle.

Because the present technology involves communication between two modules located on separate rail line vehicles, and a determination of a relative ***separation distance***, the present

technology is capable of operating independent of any fixed transmitters. Accordingly, for at least these reasons, the non-rail disclosures of Breed do not anticipate the pending claims of the present application, which all require use of rail line vehicles.

Breed does not relate to rail line vehicles

Breed describes image and distance monitoring for vehicular applications. (Breed, Title.) Breed does not disclose modules mounted, or used in any way, with ***rail line vehicles***. Each claim of the present application, however, recites several elements that either require a rail line vehicle or rail equipment, or interaction with a rail line vehicle or rail equipment. Accordingly, as a technical matter, Breed cannot anticipate the claims of the present application, because it does not teach "each and every element" set forth in the claims.

Moreover, because Breed does not relate to rail vehicles, it does not operate in the same manner as the present technology. Rail vehicles generally travel along a rail line with only one degree of freedom in which to travel. That is, rail vehicles can generally only travel forward or backward along a single rail line. And in a particular work gang, there will only be one or two vehicles (i.e., the vehicles immediately in front of and behind) that each vehicle must be concerned with tracking. For this reason, it is valuable for each rail vehicle to be aware of a ***separation distance*** between itself and the vehicle in front of and/or behind it. Because there are a limited number of vehicles to be concerned with, rail lines are particularly suitable for the present technology, which uses time of flight and direct communication between a limited number of modules.

Breed relates to ***roadway*** vehicles, which do not travel along one-dimensional rails. As a result, Breed is concerned with all vehicles in a two or three dimensional vicinity. Breed, therefore, relies on the determination of the actual or relative location of a vehicle with respect to fixed transmitter, not a ***separation distance*** between two vehicles. (Breed at [0183].) That is,

the operation of Breed is concerned with a relative position with respect to a reference point, not with respect to one or more proximate vehicles traveling on a shared one-dimensional track.

Additionally, rail vehicles are typically very heavy, and operate with steel wheels on a steel track. This combination of features makes it very difficult to accurately determine the time and distance each vehicle will take to be brought to a stop. Weather conditions or other variables, such as oil on the track can cause enormous variability in the stopping distances of rail vehicles. Roadway vehicles, on the other hand, such as those disclosed in Breed, employ rubber wheels on pavement, a contact surface that is far less affected by changing exterior conditions. As a result, Breed does not need to monitor the separation of vehicles with the precision and care provided by the presently claimed technology. Accordingly, for at least these reasons, the non-rail disclosures of Breed do not anticipate the pending claims of the present application, which all require use of rail line vehicles.

Breed Does Not Anticipate Or Render Obvious The Dependent Claims

As noted, Breed does not anticipate or render obvious the independent claims of the present application. As such, Breed can neither anticipate, nor render obvious the dependent claims of the present application, which necessarily incorporate all of the limitations recited in the independent claims. However, there are several reasons why various dependent claims should be considered allowable over and above the independent claims.

Dependent Claims 29-30, and 44

Dependent claims 30-31 and 44 recite an auxiliary transponder sensor module, or a second antenna, mounted on the first rail line vehicle with an offset with respect to the first transponder sensor module/antenna. As the present application explains, this offset can be provided to address issues caused by Fresnel zone effects. That is, the offset feature can be used to address issues caused by reflective signals that may be altered before they are received.

The Office Action acknowledges that Breed does not teach a vehicle with transponder sensor modules mounted offset from one another on a given vehicle. (Office Action at 20.) The Office Action instead suggests that the Shostak reference teaches mounting ultra wideband units from one another. (*See* Office Action at 20 (citing Shostak at [0916]).) However, as Shostak makes clear, this offset is provided to use phase to offset simultaneous signals. (Shostak [0916]) Shostak does not offset antennae to compensate for Fresnel zone effects. Indeed, Shostak does not even discuss the problems that could be alleviated by the use of the auxiliary transponder sensor modules and/or antennae. Accordingly, a person of ordinary skill in the art would not be motivated to consider the Shostak disclosure as a way to modify the shortcomings of Breed.

For at least these reasons, dependent claims 29-30 and 44 are patentable over and above the reasons provided above with respect to the independent claims.

Dependent Claims 39 and 40

Claims 39 and 40 recite a feature that actually ***measures*** a stopping distance of a rail line vehicle. As explained in the specification of the present application, the present technology actually ***measures*** the stopping distance as a calibration feature determined based on data obtained during stopping distance tests. (*See, e.g.*, Present Application at [000116].) Knowing the actually ***measured*** stopping distance allows the present technology to determine thresholds and alarms that are based on the ***measured*** stopping distance to ensure that two vehicles do not approach a separation that is less than the stopping distance.

Addressing previous claim 17, the Office Action pointed to Breed as teaching a module allegedly capable of measuring stopping distance. But Breed does not teach ***measuring*** a stopping distance. Rather, Breed merely provides range-gating that limits speed to allow for a theoretical or estimated stopping distance. As noted above, because Breed addresses roadway vehicles (with rubber tires on pavement), there is far less variability in the way that conditions

can affect the stopping distance calculation. Railway vehicles, on the other hand, involve heavy machines that have steel wheels on steel tracks, and the friction between steel and steel can be widely affected by conditions such as rain, ice, or oil. As a result, simply estimating a stopping distance is not sufficient for rail vehicles. The stopping distance should be actually ***measured***, which is provided for by the presently claimed technology.

For at least these reasons, the dependent claims, particularly dependent claims 39 and 40 are patentable over and above the reasons provided above with respect to the independent claims. Accordingly, Applicant respectfully requests a notice of allowability at least with respect to these dependent claims.

CONCLUSION

In view of the foregoing amendments and remarks, Applicant submits that the claims are in condition for allowance over the cited references. If the Examiner has any questions or the Applicant can be of any assistance, the Examiner is invited and encouraged to contact the Applicant's undersigned attorney at (312) 775-8094.

In general, the Office Action makes various statements regarding the claims and the cited reference that are now moot in light of the above. However, Applicant expressly reserves the right to challenge such statements in the future should the need arise (e.g., if such statements should become relevant by appearing in a rejection of any current or future claim).

This response is timely submitted in advance of the due date of December 2, 2013, along with a petition for a one month extension of time and the associated fee. No additional fees are due at this time, but the Commissioner is authorized to charge any additional fee which may be required, or credit any overpayment to Deposit Account No. 13-0017.

Respectfully submitted,

Date: December 2, 2013

/Michael J. Krautner/
Michael J. Krautner
Registration No. 59,218
Attorney for Applicant

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500 West Madison Street
34th Floor
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Electronic Patent Application Fee Transmittal

Application Number:	13474428
Filing Date:	17-May-2012
Title of Invention:	COLLISION AVOIDANCE SYSTEM FOR RAIL LINE VEHICLES
First Named Inventor/Applicant Name:	Richard C. Carlson
Filer:	Michael J. Krautner/Shirley Beckmann
Attorney Docket Number:	24983US02

Filed as Small Entity

Utility under 35 USC 111(a) Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Extension - 1 month with $0 paid	2251	1	100	100

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
			Total in USD ($)	**100**

Electronic Acknowledgement Receipt

EFS ID:	17538309
Application Number:	13474428
International Application Number:	
Confirmation Number:	6724
Title of Invention:	COLLISION AVOIDANCE SYSTEM FOR RAIL LINE VEHICLES
First Named Inventor/Applicant Name:	Richard C. Carlson
Customer Number:	23446
Filer:	Michael J. Krautner/Shirley Beckmann
Filer Authorized By:	Michael J. Krautner
Attorney Docket Number:	24983US02
Receipt Date:	02-DEC-2013
Filing Date:	17-MAY-2012
Time Stamp:	14:34:49
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$100
RAM confirmation Number	975
Deposit Account	130017
Authorized User	KRAUTNER, MICHAEL J

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

Charge any Additional Fees required under 37 C.F.R. Section 1.16 (National application filing, search, and examination fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.19 (Document supply fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.20 (Post Issuance fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Extension of Time	Extension_of_Time__Regular_sb22.pdf	215508 4f4ea6e621ed4bf3db00a89a0339fe7321d4e148	no	2
Warnings:					
Information:					
2		24983US02_Response_to_OA.pdf	85481 7c87cf249feb29e6cf4fd2c506406e0ec945ce4b	yes	16

Multipart Description/PDF files in .zip description

Document Description	Start	End
Amendment/Req. Reconsideration-After Non-Final Reject	1	1
Claims	2	8
Applicant Arguments/Remarks Made in an Amendment	9	16

Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	30327 0c016fef2b359c4bb1794b040d5668b2cca27cb9	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	331316		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/22 (03-13)
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PETITION FOR EXTENSION OF TIME UNDER 37 CFR 1.136(a)

Docket Number (Optional): 24983US02

Application Number: 13/474,428

Filed: May 17, 2012

For: COLLISION AVOIDANCE SYSTEM FOR RAIL LINE VEHICLES

Art Unit: 3662

Examiner: Robert T. Payne

This is a request under the provisions of 37 CFR 1.136(a) to extend the period for filing a reply in the above-identified application.

The requested extension and fee are as follows (check time period desired and enter the appropriate fee below):

		Fee	Small Entity Fee	Micro Entity Fee	
☑	One month (37 CFR 1.17(a)(1))	$200	$100	$50	$ 100.00
☐	Two months (37 CFR 1.17(a)(2))	$600	$300	$150	$
☐	Three months (37 CFR 1.17(a)(3))	$1,400	$700	$350	$
☐	Four months (37 CFR 1.17(a)(4))	$2,200	$1,100	$550	$
☐	Five months (37 CFR 1.17(a)(5))	$3,000	$1,500	$750	$

☑ Applicant asserts small entity status. See 37 CFR 1.27.

☐ Applicant certifies micro entity status. See 37 CFR 1.29.
Form PTO/SB/15A or B or equivalent must either be enclosed or have been submitted previously.

☐ A check in the amount of the fee is enclosed.

☐ Payment by credit card. Form PTO-2038 is attached.

☐ The Director has already been authorized to charge fees in this application to a Deposit Account.

☐ The Director is hereby authorized to charge any fees which may be required, or credit any overpayment, to Deposit Account Number _____.

☑ Payment made via EFS-Web.

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

I am the

☐ applicant/inventor.

☐ assignee of record of the entire interest. See 37 CFR 3.71. 37 CFR 3.73(b) statement is enclosed (Form PTO/SB/96).

☑ attorney or agent of record. Registration number 59,218.

☐ attorney or agent acting under 37 CFR 1.34. Registration number _____.

/Michael J. Krautner/ — Signature

December 2, 2013 — Date

Michael J. Krautner — Typed or printed name

312 775-8000 — Telephone Number

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. Submit multiple forms if more than one signature is required, see below*.

☑ * Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.136(a). The information is required to obtain or retain a benefit by the public, which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 6 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number	Filing Date	☐ To be Mailed
13/474,428	05/17/2012	

ENTITY: ☐ LARGE ☒ SMALL ☐ MICRO

APPLICATION AS FILED – PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT **12/02/2013**

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	* 28	Minus	** 24	= 4	X $40 =	160
Independent (37 CFR 1.16(h))	* 3	Minus	***3	= 0	X $210 =	0
☐ Application Size Fee (37 CFR 1.16(s))						
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
					TOTAL ADD'L FEE	**160**

AMENDMENT

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =	
☐ Application Size Fee (37 CFR 1.16(s))						
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
					TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

LIE
/STEFANIE BRYCE/

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

23446 7590 01/17/2014

MCANDREWS HELD & MALLOY, LTD
500 WEST MADISON STREET
SUITE 3400
CHICAGO, IL 60661

EXAMINER
PAYNE, ROBERT T

ART UNIT	PAPER NUMBER
3661	

DATE MAILED: 01/17/2014

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/474,428	05/17/2012	Richard C. Carlson	24983US02	6724

TITLE OF INVENTION: COLLISION AVOIDANCE SYSTEM FOR RAIL LINE VEHICLES

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$480	$0	$0	$480	04/17/2014

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

23446 7590 01/17/2014
MCANDREWS HELD & MALLOY, LTD
500 WEST MADISON STREET
SUITE 3400
CHICAGO, IL 60661

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission
I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/474,428	05/17/2012	Richard C. Carlson	24983US02	6724

TITLE OF INVENTION: COLLISION AVOIDANCE SYSTEM FOR RAIL LINE VEHICLES

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$480	$0	$0	$480	04/17/2014

EXAMINER	ART UNIT	CLASS-SUBCLASS
PAYNE, ROBERT T	3661	701-301000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
- ❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
- ❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.
1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. The following fee(s) are submitted:
- ❑ Issue Fee
- ❑ Publication Fee (No small entity discount permitted)
- ❑ Advance Order - # of Copies _____

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**
- ❑ A check is enclosed.
- ❑ Payment by credit card. Form PTO-2038 is attached.
- ❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credits any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)
- ❑ Applicant certifying micro entity status. See 37 CFR 1.29 — NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
- ❑ Applicant asserting small entity status. See 37 CFR 1.27 — NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
- ❑ Applicant changing to regular undiscounted fee status. — NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/474,428	05/17/2012	Richard C. Carlson	24983US02	6724

23446 7590 01/17/2014

MCANDREWS HELD & MALLOY, LTD
500 WEST MADISON STREET
SUITE 3400
CHICAGO, IL 60661

EXAMINER	
PAYNE, ROBERT T	

ART UNIT	PAPER NUMBER
3661	

DATE MAILED: 01/17/2014

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment to date is 0 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 0 day(s).

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

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The information provided by you in this form will be subject to the following routine uses:

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2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 13/474,428	Applicant(s) CARLSON ET AL.	
	Examiner ROBERT PAYNE	Art Unit 3661	AIA (First Inventor to File) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *Response filed on December 2, 2013*.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on_____.
2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.
3. ☒ The allowed claim(s) is/are *25-52*. As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov .
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some *c) ☐ None of the:
   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☒ Notice of References Cited (PTO-892)
2. ☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
5. ☐ Examiner's Amendment/Comment
6. ☒ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/ROBERT PAYNE/ Examiner, Art Unit 3661	/THOMAS BLACK/ Supervisory Patent Examiner, Art Unit 3661

DETAILED ACTION

Claims 1-24 have been canceled and claims 25-52 have been `.

Allowable Subject Matter

The following is a statement of reasons for the indication of allowable subject matter: the closest prior art of record is Rubin et al., US publication number 20130279392. Rubin et al. disclose a transceiver and a vehicle-2-vehicle (V2V) communication and safety system that regularly broadcast safety messages, comprising location, heading and speed, of a subject vehicle, that are free of MAC and IP addresses. The V2V system uses the location of the subject vehicle for vehicle identification, in place of a pre-assigned vehicle ID. Some embodiments broadcast safety message in self-assigned timeslots in a synchronized TDMA broadcast architecture, with unusually short inter-message gaps and unusually short messages. The TDMA frame is partitioned into three prioritize time interval classes with differing priorities and dynamically changing sizes based on demand of higher-priority messages. Timeslot selection uses weighted algorithms. Selected timeslots are held until either a message collision or a timeout occurs, a transceiver equipped vehicle may proxy a different subject vehicle. Embodiments include optimize traffic flow and signal timing.

Concerning claims 25-52, Rubin et al taken either individually or in combination with other prior art of record fails to teach or render obvious "… Where in each vehicle mounted module is operable to communicate with at least one other vehicle mounted module mounted on at least one other real vehicle, and wherein each vehicle mounted module is operable to apply a time of flight technique to determine a separation distance between the rail vehicles "employee time of flight techniques to detect a distance between rail vehicles "… Where in each of the 2 or

more real vehicle modules communicate to determine a separation distance between each rail vehicle, and wherein each real vehicle module is operable to use information provided by the radio communications unit in the global positioning system unit, to determine whether one or more vehicle separation criteria are violated, and to generate a warning signal if one or more vehicle separation criteria are violated ".

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to ROBERT PAYNE whose telephone number is (571)272-3241. The examiner can normally be reached on Monday-Thursday from 8:30 AM to 6:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Thomas Black can be reached on (571)-272-6956. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

ROBERT T PAYNE
Examiner
Art Unit 3661

/THOMAS BLACK/
Supervisory Patent Examiner, Art Unit 3661

Notice of References Cited	Application/Control No. 13/474,428	Applicant(s)/Patent Under Reexamination CARLSON ET AL.	
	Examiner ROBERT PAYNE	Art Unit 3661	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-5,904,210 A	05-1999	Stump et al.	175/45
*	B	US-2013/0279392 A1	10-2013	Rubin et al.	370/312
*	C	US-2013/0279491 A1	10-2013	Rubin et al.	370/347
*	D	US-2013/0279393 A1	10-2013	Rubin et al.	370/312
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L13	81293	(Time$4) near10 (flight$4)	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	NEAR	ON	2014/01/13 10:35
L14	76860	L13 and (technique$4 or method$4 or system$4 or practic$4 or procedur$4 or perform$4 or skill$4)	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	NEAR	ON	2014/01/13 10:35
L15	50862	L14 and (global$4 or worldwid$4 or international$4 or universal$4 or total$4 or comprehensiv$4)	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	NEAR	ON	2014/01/13 10:35
L16	91	L15 and (transponder) near20 (position$4 or locat6 or plac$4 or sit$4 or spot$4 or station$4) near40 (satellite)	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	NEAR	ON	2014/01/13 10:35
L17	4720	L13 and (collision or crash or smash or accident or impact or pile-up or (pile) near (up)) near20 (avoid$7 or evasion$4 or escap$4 or prevent$4 or stop$7 or forestall$5 or avert$6)	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	NEAR	ON	2014/01/13 10:35
L18	4683	L17 and L14	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	NEAR	ON	2014/01/13 10:35
L19	3692	L18 and L15	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	NEAR	ON	2014/01/13 10:35
L20	18	L19 and L16	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	NEAR	ON	2014/01/13 10:35
L21	18	L19 and L16	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	NEAR	ON	2014/01/13 10:39
L22	21693	Collision near avoidance	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	NEAR	ON	2014/01/13 10:41

L23	1597	L22 and L13	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	NEAR	ON	2014/01/13 10:41
L24	1597	L23 and L14	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	NEAR	ON	2014/01/13 10:42
L25	1364	L24 and L15	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	NEAR	ON	2014/01/13 10:43
L26	8	L25 and L16	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	NEAR	ON	2014/01/13 10:43
L27	8	L26 and L17	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	NEAR	ON	2014/01/13 10:44
L28	8	L27 and L18	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	NEAR	ON	2014/01/13 10:45
S1	81262	(Time$4) near10 (flight$4)	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	NEAR	ON	2014/01/09 16:17
S2	76832	S1 and (technique$4 or method$4 or system$4 or practic$4 or procedur$4 or perform$4 or skill$4)	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	NEAR	ON	2014/01/09 16:18
S3	50862	S2 and (global$4 or worldwid$4 or international$4 or universal$4 or total$4 or comprehensiv$4)	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	NEAR	ON	2014/01/09 16:20
S4	91	S3 and (transponder) near20 (position$4 or locat6 or plac$4 or sit$4 or spot$4 or station$4) near40 (satellite)	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	NEAR	ON	2014/01/09 16:24
S5	21	S4 and (vehicl$4 or car$4 or bus$4 or Van$4 or automobil$4 or truck$4 or train$4 or locomotiv$4) near20 (position$4 or locat6 or plac$4 or sit$4 or spot$4 or station$4) near40 (satellite)	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	NEAR	ON	2014/01/09 16:26
S6	4	S5 and (detect$4 or notic$4 or sens$4 or perceiv$4 or identify$4 or discover$4 or find$4 or reveal$4 or expos4) near20 (distanc$4 or avoid$4 or vast$7 or	US-PGPUB; USPAT; FPRS; EPO; JPO;	NEAR	ON	2014/01/09 16:37

		gap$4) near40 (between$4)	DERWENT			
S7	4720	S1 and (collision or crash or smash or accident or impact or pile-up or (pile) near (up)) near20 (avoid$7 or evasion$4 or escap$4 or prevent$4 or stop$7 or forestall$5 or avert$6)	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	NEAR	ON	2014/01/09 16:44
S8	4683	S7 and S2	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	NEAR	ON	2014/01/09 16:45
S9	3692	S8 and S3	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	NEAR	ON	2014/01/09 16:46
S10	18	S9 and S4	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	NEAR	ON	2014/01/09 16:46
S11	6	S10 and S5	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT	NEAR	ON	2014/01/09 16:46

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	65627	(Time$4) near10 (flight$4)	US-PGPUB; USPAT; UPAD	NEAR	ON	2014/01/13 10:27
L2	65332	l1 and (technique$4 or method$4 or system$4 or practic$4 or procedur$4 or perform$4 or skill$4)	US-PGPUB; USPAT; UPAD	NEAR	ON	2014/01/13 10:28
L3	49835	l2 and (global$4 or worldwid$4 or international$4 or universal$4 or total$4 or comprehensiv$4)	US-PGPUB; USPAT; UPAD	NEAR	ON	2014/01/13 10:28
L4	90	l3 and (transponder) near20 (position$4 or locat6 or plac$4 or sit$4 or spot$4 or station$4) near40 (satellite)	US-PGPUB; USPAT; UPAD	NEAR	ON	2014/01/13 10:29
L5	21	l4 and (vehicl$4 or car$4 or bus$4 or Van$4 or automobil$4 or truck$4 or train$4 or locomotiv$4) near20 (position$4 or locat6 or plac$4 or sit$4 or spot$4 or station$4) near40 (satellite)	US-PGPUB; USPAT; UPAD	NEAR	ON	2014/01/13 10:29
L6	4	l5 and (detect$4 or notic$4 or sens$4 or perceiv$4 or identify$4 or discover$4 or find$4 or reveal$4 or expos4) near20 (distanc$4 or avoid$4 or vast$7 or gap$4) near40 (between$4)	US-PGPUB; USPAT; UPAD	NEAR	ON	2014/01/13 10:30
L7	3683	"l7" and "S2"	US-PGPUB;	NEAR	ON	2014/01/13 10:31

			USPAT; UPAD			
L8	183	"l8" and l3	US-PGPUB; USPAT; UPAD	NEAR	ON	2014/01/13 10:32
L9	183	l8 and l3	US-PGPUB; USPAT; UPAD	NEAR	ON	2014/01/13 10:33
L10	0	l9 and l4	US-PGPUB; USPAT; UPAD	NEAR	ON	2014/01/13 10:33
L11	0	l9 and l4	US-PGPUB; USPAT; UPAD	NEAR	ON	2014/01/13 10:34
L12	0	l9 and l5	US-PGPUB; USPAT; UPAD	NEAR	ON	2014/01/13 10:34

1/13/2014 11:00:04 AM
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Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	13474428	CARLSON ET AL.
	Examiner	Art Unit
	ROBERT PAYNE	3662

CPC- SEARCHED		
Symbol	Date	Examiner

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner
342	53	7/23/2013	RP
340	905	7/23/2013	RP
342	115	7/23/2013	RP
342	118	7/23/2013	RP
342	125	7/23/2013	RP
701	408	7/23/2013	RP
701	301	7/23/2013	RP
701	29.6	7/23/2013	RP
701	34.3	7/23/2013	RP
701	36	7/23/2013	RP
701	19	7/23/2013	RP
701	34.3	7/23/2013	RP
342	70	7/23/2013	RP
340	905	7/23/2013	RP
701	13	7/23/2013	RP
701	23	7/23/2013	RP
701	4	7/16/2013	RP
701	117	7/16/2013	RP
701	468	7/23/2013	RP
701	409	7/23/2013	RP
701	63	7/23/2013	RP
701	19	7/23/2013	RP
701	28	7/23/2013	RP
701	1	7/23/2013	RP
701	116	7/23/2013	RP
701	500	7/23/2013	RP

US CLASSIFICATION SEARCHED			
Class	**Subclass**	**Date**	**Examiner**
701	2	7/23/2013	RP
701	46	7/23/2013	RP
701	23	7/16/2013	RP

SEARCH NOTES		
Search Notes	**Date**	**Examiner**
Searched East US-PGPUB, USPAT, FPRS, EPO, JPO Derwent	7/23/2013	RP
Searched East US-PGPUB, USPAT, FPRS, BPO, JPO and Derwent	1/13/2014	RP

INTERFERENCE SEARCH			
US Class/ CPC Symbol	**US Subclass / CPC Group**	**Date**	**Examiner**
701	301	1/13/2014	RP
701	408	1/13/2014	RP
701	29.6	1/13/2014	RP
701	33.4	1/13/2014	RP
701	36	1/13/2014	RP
701	19	1/13/2014	RP
701	34.3	1/13/2014	RP
370	312	1/13/2014	RP
175	45	1/13/2014	RP
370	347	1/13/2014	RP
370	312	1/13/2014	RP
701	14	1/13/2014	RP
701	300	1/13/2014	RP

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	13474428	CARLSON ET AL.
	Examiner	**Art Unit**
	ROBERT PAYNE	3661

CPC		
Symbol	**Type**	**Version**

CPC Combination Sets				
Symbol	**Type**	**Set**	**Ranking**	**Version**

/ROBERT PAYNE/ Examiner.Art Unit 3661	1/13/2014	**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	27	
/THOMAS BLACK/ Supervisory Patent Examiner.Art Unit 3661	01/13/2014	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	13474428	CARLSON ET AL.
	Examiner	**Art Unit**
	ROBERT PAYNE	3661

US ORIGINAL CLASSIFICATION		INTERNATIONAL CLASSIFICATION												
CLASS	SUBCLASS	CLAIMED					NON-CLAIMED							
701	301	G	0	5	D	1 / 02 (2006.01.01)								
CROSS REFERENCE(S)		G	0	6	F	17 / 10 (2006.01.01)								
		G	0	6	G	7 / 78 (2006.01.01)								
CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)													
701	300													

/ROBERT PAYNE/ Examiner.Art Unit 3661	1/13/2014	**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	27	
/THOMAS BLACK/ Supervisory Patent Examiner.Art Unit 3661	01/13/2014	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	13474428	CARLSON ET AL.
	Examiner	**Art Unit**
	ROBERT PAYNE	3661

☒ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
	1		17	9	33	24	49								
	2		18	10	34	25	50								
	3		19	11	35	26	51								
	4		20		36	27	52								
	5		21	13	37										
	6		22	14	38										
	7		23	15	39										
	8		24	16	40										
	9	1	25	17	41										
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	11	3	27	18	43										
	12	4	28	19	44										
	13	5	29	20	45										
	14	6	30	21	46										
	15	7	31	22	47										
	16	8	32	23	48										

/ROBERT PAYNE/ Examiner.Art Unit 3661	1/13/2014	**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	27	
/THOMAS BLACK/ Supervisory Patent Examiner.Art Unit 3661	01/13/2014	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	13474428	CARLSON ET AL.
	Examiner	**Art Unit**
	ROBERT PAYNE	3662

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	07/23/2013	01/06/2014	01/06/2014	01/06/2014					
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	24	✓	-							
	25		=							
	26		=							
	27		=							
	28		=							
	29		=							

PTO/SB/08a (01-10)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	13474428
Filing Date	2012-05-17
First Named Inventor	Richard C. Carlson
Art Unit	3661
Examiner Name	Robert T. Payne
Attorney Docket Number	24983US02

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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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	1	20080150786		2008-06-26	Breed	
	2	20060025897		2006-07-30	Shostak	
	3	20100207787		2010-08-19	Catten	

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	1							☐

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	13474428
	Filing Date	2012-05-17
	First Named Inventor	Richard C. Carlson
	Art Unit	3661
	Examiner Name	Robert T. Payne
	Attorney Docket Number	24983US02

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	1	PCT Notification Concerning Transmittal of Copy of International Preliminary Report on Patentability in International applciation no. PCT/US2012/038332, dated November 28, 2013. (7 pages).	☐
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Examiner Signature		Date Considered	

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[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	13474428
Filing Date	2012-05-17
First Named Inventor	Richard C. Carlson
Art Unit	3661
Examiner Name	Robert T. Payne
Attorney Docket Number	24983US02

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☒ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☒ Fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☐ None

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Michael J. Krautner/	Date (YYYY-MM-DD)	2014-02-20
Name/Print	Michael J. Krautner	Registration Number	59,218

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION CONCERNING TRANSMITTAL OF COPY OF INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY (CHAPTER I OF THE PATENT COOPERATION TREATY)
(PCT Rule 44bis.1(c))

To:

SHOOKMAN, Jeb, A.
McAndrews Held and Malloy
500 W. Madison, Suite 3400
Chicago, IL 60661
ETATS-UNIS D'AMERIQUE

Date of mailing *(day/month/year)* 28 November 2013 (28.11.2013)	
Applicant's or agent's file reference 24983WO01	IMPORTANT NOTICE

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US2012/038332	17 May 2012 (17.05.2012)	19 May 2011 (19.05.2011)

Applicant
METROM RAIL, LLC et al

The International Bureau transmits herewith a copy of the international preliminary report on patentability (Chapter I of the Patent Cooperation Treaty)

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No. +41 22 338 82 70

Authorized officer
Agnès Wittmann-Regis

e-mail: pt06.pct@wipo.int

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY
(Chapter I of the Patent Cooperation Treaty)

(PCT Rule 44*bis*)

Applicant's or agent's file reference 24983WO01	**FOR FURTHER ACTION**	See item 4 below
International application No. PCT/US2012/038332	International filing date *(day/month/year)* 17 May 2012 (17.05.2012)	Priority date *(day/month/year)* 19 May 2011 (19.05.2011)
International Patent Classification (8th edition unless older edition indicated) See relevant information in Form PCT/ISA/237		
Applicant METROM RAIL, LLC		

1. This international preliminary report on patentability (Chapter I) is issued by the International Bureau on behalf of the International Searching Authority under Rule 44 *bis*.1(a).

2. This REPORT consists of a total of 6 sheets, including this cover sheet.

   In the attached sheets, any reference to the written opinion of the International Searching Authority should be read as a reference to the international preliminary report on patentability (Chapter I) instead.

3. This report contains indications relating to the following items:

☒	Box No. I	Basis of the report
☐	Box No. II	Priority
☐	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
☐	Box No. IV	Lack of unity of invention
☒	Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
☐	Box No. VI	Certain documents cited
☐	Box No. VII	Certain defects in the international application
☐	Box No. VIII	Certain observations on the international application

4. The International Bureau will communicate this report to designated Offices in accordance with Rules 44*bis*.3(c) and 93*bis*.1 but not, except where the applicant makes an express request under Article 23(2), before the expiration of 30 months from the priority date (Rule 44*bis* .2).

	Date of issuance of this report 19 November 2013 (19.11.2013)
The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No. +41 22 338 82 70	Authorized officer Agnès Wittmann-Regis e-mail: pt06.pct@wipo.int

Form PCT/IB/373 (January 2004)

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To: JEB A. SHOOKMAN
MCANDREWS HELD AND MALLOY
500 W. MADISON, SUITE 3400
CHICAGO, IL 60661

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing *(day/month/year)*	13 JUL 2012
Applicant's or agent's file reference 24983WO01	**FOR FURTHER ACTION** See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US 12/38332	17 May 2012 (17.05.2012)	19 May 2011 (19.05.2011)

International Patent Classification (IPC) or both national classification and IPC
IPC(8) - G06F 17/10 (2012.01)
USPC - 701/301

Applicant METROM RAIL, LLC

1. This opinion contains indications relating to the following items:

- [X] Box No. I Basis of the opinion
- [ ] Box No. II Priority
- [ ] Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- [ ] Box No. IV Lack of unity of invention
- [X] Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- [ ] Box No. VI Certain documents cited
- [ ] Box No. VII Certain defects in the international application
- [ ] Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1 *bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to th IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Fom PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA/US	Date of completion of this opinion	Authorized officer:
Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	03 July 2012 (03.07.2012)	Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/237 (cover sheet) (July 2011)

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 12/38332

Box No. I Basis of this opinion

1. With regard to the **language**, this opinion has been established on the basis of:

   ☒ the international application in the language in which it was filed.

   ☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(a))

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing filed or furnished:

   a. (means)

      ☐ on paper

      ☐ in electronic form

   b. (time)

      ☐ in the international application as filed

      ☐ together with the international application in electronic form

      ☐ subsequently to this Authority for the purposes of search

4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 12/38332

Box No. V **Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Claims	11-12, 14-16	YES
	Claims	1-10, 13, 17-24	NO
Inventive step (IS)	Claims	None	YES
	Claims	1-24	NO
Industrial applicability (IA)	Claims	1-24	YES
	Claims	None	NO

2. Citations and explanations:

Claims 1-10, 13, and 17-24 lack novelty under PCT Article 33(2) as being anticipated by US 2008/0150786 A1 to Breed.

As to claim 1, Breed teaches a rail line vehicle having a vehicle mounted module, the vehicle mounted module comprising a transponder sensor module including an ultra wideband unit and a wireless communications antenna, wherein the ultra wideband unit is operable to detect a distance between the rail line vehicle and at least one other vehicle, wherein the wireless communications antenna is operable to send and receive data over the air ("Vehicle 18 contains two receivers 160,161 for the micropower impulse radar (MIR) implementation of the invention. MIR or ultrawideband (UWB) transmitter devices are placed at locations 151, 152 and 153 respectively," para [0183]); a control electronics module including a processor that is in communication with at least the ultra wideband unit ("A vehicle 246 includes an antenna 248 coupled to a control module, control unit, processor or computer 250. The antenna, which can be an imager, 248 receives transmissions (waves or wireless signals) including transmissions 252 when in range of the transmitters," para [0213]); and a user interface module including a user interface, wherein the user interface is operable to provide a vehicle operator with information and is operable to accept input from the vehicle operator ("a user input device on the vehicle which enables an occupant of the vehicle to request information to be transmitted via the transmitter," para [0366]).

As to claim 2, Breed teaches the rail line vehicle of claim 1 wherein the vehicle mounted module is in communication with one or more central tracking units by way of the wireless communications antenna, wherein the one or more central tracking units are operable to track the location of the rail line vehicle and at least one other vehicle ("communications with precise positioning stations for GPS independent location determination," para [0368]).

As to claim 3, Breed teaches the rail line vehicle of claim 1 wherein the vehicle mounted module further comprises a central tracking unit module that is operable to track the location of at least one other vehicle (" management of the database may include transmitting from the vehicle requests, for example, to other vehicles, a central map management facility or infrastructure, to ascertain whether the database has current map data for the current location of the vehicle and surrounding locations," para [0155]; "The system described herein also permits better simultaneous tracking of several vehicles," para [0309]).

As to claim 4, Breed teaches the rail line vehicle of claim 1 wherein the transponder sensor module further includes a global positioning system, wherein the global positioning system is operable to receive information from one or more satellites and is operable to determine the absolute position of the rail line vehicle ("initially, it is preferred to use the GPS navigational satellites as the base technology," para [0159]).

As to claim 5, Breed teaches the rail line vehicle of claim 4 wherein the vehicle mounted module is operable to utilize information generated by the global positioning system and the ultra wideband unit to determine whether one or more vehicle separation criteria are violated, and generate a warning if one or more vehicle separation criteria are violated ("the extraction of information from radio frequency wave transmission may be limited based on a threshold determination (a filter of sorts) as to whether the transmission is of potential interest, e.g., to the operation of the vehicle based on its position, location and/or motion," para [0214]; "Other reactive systems 265 are also envisioned, e.g., a warning system to warn the driver of the vehicle about the presence of another vehicle within a threshold distance form the vehicle," para [0272]).

As to claim 6, Breed teaches the rail line vehicle of claim 1 wherein the user interface module further includes a service interface operable to allow the vehicle operator to configure, calibrate, service, maintain, diagnose, update and/or install information on vehicle mounted module ("calibration system," para [0200]; "the diagnostic or prognostic determination is transmitted from the vehicle to a transmitter which in turn can direct the determination to a dealer, manufacturer, vehicle owner and/or service center," para [0368]; "diagnostic and prognostic telematics communications," para [0397]).

As to claim 7, Breed teaches the rail line vehicle of claim 1 wherein the control electronics module further includes one or more interfaces that are operable to communicate with ground speed detection modules ("ground speed monitoring system using lasers, radar or ultrasonics," para [0502]).

As to claim 8, Breed teaches the rail line vehicle of claim 7 wherein the ground speed detection modules include one or more of a microwave radar, a laser device, an infrared sensor and an ultra wideband sensor (para [0502]).

(PLEASE SEE SUPPLEMENTAL BOX)

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 12/38332

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:
Box V.2 - Citations and explanations:

As to claim 9, Breed teaches the rail line vehicle of claim 1 wherein the control electronics module further includes one or more inertial measurement units ("The inertial navigation system (INS), sometimes called the inertial reference unit or IRU, comprises one or more accelerometers 78 and one or more gyroscopes," para [0503]).

As to claim 10, Breed teaches the rail line vehicle of claim 1 wherein the vehicle mounted modules comprises one or more additional transponder sensor modules, wherein the vehicle mounted module is operable to accept calibration information regarding the length of the rail line vehicle and the mounting locations of the transponder sensor module and the one or more additional transponder sensor modules ("Extension assembly 214 can include a mounting bracket 216 from the roof of the vehicle 200 forward to each data acquisition module 210, a mounting bracket 218 extending from the front bumper upward to each data acquisition module 202 and a cross mounting bracket 220 extending between the data acquisition modules 202 for support. Since all of the data acquisition equipment is co-located, its precise location is accurately determined by the IMU, the mounting location on the vehicle and the differential GPS system," para [0139]).

As to claim 13, Breed teaches the rail line vehicle of claim 1 wherein the transponder sensor module further includes one or more of a laser device, a radar sensor and an infrared sensor (para [0502]).

As to claim 17, Breed teaches the rail line vehicle of claim 1 wherein the vehicle mounted module is operable to utilize a stopping distance calibration feature that measures a stopping distance, wherein the stopping distance indicates how quickly the rail line vehicle can stop under current conditions ("Range-gating on the imaging system or reflection measurements on the laser radar units can be used to measure the driver's sight distance and the speed of the vehicle can then be limited to a speed that allows for a safe stopping distance between the vehicle and another vehicle or object that may be in the path of the vehicle or on a collision path with the vehicle," para [0272]).

As to claim 18, Breed teaches the rail line vehicle of claim 17 wherein the measured stopping distance is used to modify one or more safe separation distance thresholds ("if a faster moving vehicle approaches a slower moving vehicle, it will automatically slow down to keep a safe separation distance from the leading, slower moving vehicle," para [0078]).

As to claim 19, Breed teaches the rail line vehicle of claim 1 wherein the control electronics module further includes an inertial measurement unit (para [0503]).

As to claim 20, Breed teaches a collision avoidance system comprising: one or more vehicle mounted modules, each mounted on a vehicle, each vehicle mounted module comprising: a transponder sensor module including an ultra wideband unit and a wireless communications antenna, wherein the ultra wideband unit is operable to detect a distance between the vehicle on which the vehicle mounted module is mounted and at least one other vehicle, wherein the wireless communications antenna is operable to send and receive data over the air (para [0183]); a control electronics module including a processor that is in communication with at least the ultra wideband unit (para [0213]); and a user interface module including a user interface, wherein the user interface is operable to provide a vehicle operator with information and is operable to accept input from the vehicle operator (para [0366]); and a central tracking unit that is in communication with the one or more vehicle mounted modules, the central tracking unit being operable to track the location of the one or more vehicle mounted modules (para [0368]).

As to claim 21, Breed teaches the collision avoidance system of claim 20 wherein the central tracking unit is distributed among the one or more vehicle mounted modules, wherein each of the one or more vehicle mounted modules includes a central tracking unit component, each central tracking unit component is in communication with the vehicle's control electronics module (para [0135], [0139]).

As to claim 22, Breed teaches the collision avoidance system of claim 20 wherein the central tracking unit is disposed in a discrete housing ("Such a device typically has three accelerometers and three gyroscopes that are held together in a single housing," para [0114]).

As to claim 23, Breed teaches the collision avoidance system of claim 20 wherein the transponder sensor module further includes a global positioning system, wherein the global positioning system is operable to receive information from one or more satellites and is operable to determine the absolute position of the vehicle mounted module (para [0135]).

As to claim 24, Breed teaches the collision avoidance system of claim 20 wherein each vehicle mounted module is operable to utilize information generated by the global positioning system, the ultra wideband unit and the central tracking unit to determine whether one or more vehicle separation criteria are violated, and generate a warning if one or more vehicle separation criteria are violated (para [0214], [0272]).

(PLEASE SEE NEXT SUPPLEMENTAL BOX)

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 12/38332

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:
Box V.2 - Citations and explanations:

Claims 11-12 and 14 lack an inventive step under PCT Article 33(3) as being obvious over Breed in view of US 2006/0025897 A1 to Shostak et al. (hereinafter 'Shostak').

As to claim 11, Breed teaches the rail line vehicle of claim 1 but fails to explicitly teach such a vehicle wherein the vehicle mounted modules comprises an additional ultra wideband unit, wherein an offset exists between the ultra wideband unit and the additional ultra wideband unit once the two units are mounted on the rail line vehicle. However, Shostak teaches such a vehicle wherein the vehicle mounted modules comprises an additional ultra wideband unit, wherein an offset exists between the ultra wideband unit and the additional ultra wideband unit once the two units are mounted on the rail line vehicle ("Another method is to offset the antenna array, as illustrated in FIG. 21, so that the returns naturally are spaced in time," para [0916]). It would have been obvious to one of ordinary skill in the art to combine the rail line vehicle system of Breed with the support for wideband offsets of Shostak, because Breed and Shostak are directed to systems and methods for ultra wideband transponders used for vehicle sensors. Furthermore, users benefit from systems and methods adapted for wideband offsets, because such systems and methods allow for naturally spacing signals from ultra wideband transponders in time (para [0916]).

As to claim 12, Breed teaches the rail line vehicle of claim 1 but fails to explicitly teach such a vehicle wherein the ultra wideband unit is adapted to transmit and receive signals with varying center frequencies. However, Shostak teaches such a vehicle wherein the ultra wideband unit is adapted to transmit and receive signals with varying center frequencies ("the center frequency of the UWB transceiver could be hopped or swept simultaneously," para [0979]). It would have been obvious to one of ordinary skill in the art to combine the rail line vehicle system of Breed with the support for varying center frequencies of Shostak, because Breed and Shostak are directed to systems and methods for ultra wideband transponders used for vehicle sensors. Furthermore, users benefit from systems and methods adapted for varying center frequencies, because such systems and methods allow for multiple antennas (para [0979]-[0980]).

As to claim 14, Breed teaches the rail line vehicle of claim 1 but fails to explicitly teach such a vehicle wherein the user interface is a touchscreen including a screen, the touchscreen being operable to display one or more screens, menus, options and/or functions, and accept user input from the vehicle operator by allowing the vehicle operator to touch the screen of the touchscreen. However, Shostak teaches such a vehicle wherein the user interface is a touchscreen including a screen, the touchscreen being operable to display one or more screens, menus, options and/or functions, and accept user input from the vehicle operator by allowing the vehicle operator to touch the screen of the touchscreen (para [1555]). It would have been obvious to one of ordinary skill in the art to combine the rail line vehicle system of Breed with the support for touchscreens of Shostak, because Breed and Shostak are directed to systems and methods for interfaces used with vehicle sensors. Furthermore, users benefit from systems and methods adapted for touchscreens, because such systems and methods allow for touch interfaces for a wide variety of sensors (para [1555]).

Claims 15-16 lack an inventive step under PCT Article 33(3) as being obvious over Breed in view of US 2010/0207787 A1 to Catten et al. (hereinafter 'Catten').

As to claim 15, Breed teaches the rail line vehicle of claim 1 but fails to explicitly teach such a vehicle wherein the vehicle mounted module is operable to utilize a progressive warning feature that generates a warning if one or more vehicle separation thresholds are violated, wherein the rate, frequency, prominence and/or severity of the warning increases as the violation of the vehicle separation threshold becomes more critical. However, Catten teaches such a vehicle wherein the vehicle mounted module is operable to utilize a progressive warning feature that generates a warning if one or more vehicle separation thresholds are violated, wherein the rate, frequency, prominence and/or severity of the warning increases as the violation of the vehicle separation threshold becomes more critical ("the vehicle monitoring system may present single or multiple warnings or alerts to the driver both in increasing frequency and/or pitch, and/or light intensity," para [0050]). It would have been obvious to one of ordinary skill in the art to combine the rail line vehicle system of Breed with the support for increasing alert frequency of Catten, because Breed and Catten are directed to systems and methods for proximity alerts using vehicle sensors. Furthermore, users benefit from systems and methods adapted for increasing alert frequency, because such systems and methods allow for providing a changing alert to a driver based on travel conditions (para [0050]).

As to claim 16, Catten teaches the rail line vehicle of claim 15 wherein the progressive warning feature utilizes an adaptive threshold feature that modifies the one or more vehicle separation thresholds based on the speed of the rail line vehicle and the speed of one or more nearby vehicles ("the parameters used to evaluate driver behavior may be modified based upon road conditions. Additionally, the driver may be evaluated based upon his reaction to changes in road conditions and his response to warnings of changing road conditions. The monitoring levels that are set in the vehicle monitoring system may be configured to be adjusted based upon road conditions," para [0061]).

Claims 1-24 have industrial applicability as defined by PCT Article 33(4), because the subject matter can be made or used in industry.

Electronic Patent Application Fee Transmittal

Application Number:	13474428
Filing Date:	17-May-2012
Title of Invention:	COLLISION AVOIDANCE SYSTEM FOR RAIL LINE VEHICLES
First Named Inventor/Applicant Name:	Richard C. Carlson
Filer:	Michael J. Krautner/Deb Wilson
Attorney Docket Number:	24983US02

Filed as Small Entity

Utility under 35 USC 111(a) Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
Submission- Information Disclosure Stmt	2806	1	90	90
		Total in USD ($)		**90**

Electronic Acknowledgement Receipt

EFS ID:	18254414
Application Number:	13474428
International Application Number:	
Confirmation Number:	6724
Title of Invention:	COLLISION AVOIDANCE SYSTEM FOR RAIL LINE VEHICLES
First Named Inventor/Applicant Name:	Richard C. Carlson
Customer Number:	23446
Filer:	Michael J. Krautner/Deb Wilson
Filer Authorized By:	Michael J. Krautner
Attorney Docket Number:	24983US02
Receipt Date:	20-FEB-2014
Filing Date:	17-MAY-2012
Time Stamp:	15:11:52
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$90
RAM confirmation Number	1566
Deposit Account	130017
Authorized User	KRAUTNER, MICHAEL J

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

Charge any Additional Fees required under 37 C.F.R. Section 1.16 (National application filing, search, and examination fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.19 (Document supply fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.20 (Post Issuance fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal Letter	24983US02_IDSTransmittal_140220.pdf	20421 77658d9c13aff2c8218a07459e4dd7c5e5487c52	no	2
Warnings:					
Information:					
2	Information Disclosure Statement (IDS) Form (SB08)	24983US02_SB08A_140220.pdf	614757 86994d5f15109c5e4d7bd6f91115888948ff21d7	no	4
Warnings:					
Information:					
3	Non Patent Literature	PCTUS2012038332_IPRP_131128.pdf	882784 e6990e1dcbfdcf16cd50876e4aee1a32ec0140ac	no	7
Warnings:					
Information:					
4	Fee Worksheet (SB06)	fee-info.pdf	30180 ab9847274234402474a79d3ef7a67b7c61778e41	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	1548142		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

<u>New Applications Under 35 U.S.C. 111</u>
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

<u>National Stage of an International Application under 35 U.S.C. 371</u>
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

<u>New International Application Filed with the USPTO as a Receiving Office</u>
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Attorney Docket No. 24983US01

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In the Application of:
Richard C. Carlson

Serial No.: 13/474,428

Filed: May 17, 2012

For: COLLISION AVOIDANCE SYSTEM FOR RAIL LINE VEHICLES

Examiner: Robert T. Payne

Group Art Unit: 3661

Confirmation No.: 6724

Filed Electronically on:
February 20, 2014

TRANSMITTAL OF
INFORMATION DISCLOSURE STATEMENT
AFTER APPLICATION FILING DATE

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

ENCLOSURES

Enclosed are the following:

- A completed PTO form SB/08A.
- A copy of the non-patent literature reference cited in the PTO form SB/08A.

FEE PAYMENT

No fee is believed to be due; however, the Commissioner is hereby authorized to charge any additional fees which are presently required, or credit any overpayment, to Deposit Account No. 13-0017.

REQUEST FOR CONSIDERATION

This paper and enclosures are believed to be entitled to consideration under 37 C.F.R. § 1.97, based on the facts stated above.

This submission is in no way intended as an admission that the cited references constitute prior art under any subsection of 35 U.S.C. § 102 or §103. Applicant expressly retains the right to argue that any of the cited references are not indeed prior art or to take any actions necessary to remove any of the cited references from the available prior art.

The Examiner is requested to initial and return a copy of the enclosed PTO Form SB/08 to the applicants to indicate consideration of the enclosed references.

Respectfully submitted,

Dated: February 20, 2014

/Michael J. Krautner/
Michael J. Krautner
Registration No. 59,218
Attorney for applicants

McAndrews, Held & Malloy, Ltd.
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500 West Madison Street
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	13474428
Filing Date	2012-05-17
First Named Inventor	Richard C. Carlson
Art Unit	3661
Examiner Name	Robert T. Payne
Attorney Docket Number	24983US02

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	13474428
	Filing Date	2012-05-17
	First Named Inventor	Richard C. Carlson
	Art Unit	3661
	Examiner Name	Robert T. Payne
	Attorney Docket Number	24983US02

	1	Notification Concerning Transmittal of Copy of International Preliminary Report of Patentability, International Application No. PT/US12/38332, International Filing Date May 17, 2012, METROM RAIL, dated November 28, 2013, 24983WO01	☐

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EXAMINER SIGNATURE

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	13474428
Filing Date	2012-05-17
First Named Inventor	Richard C. Carlson
Art Unit	3661
Examiner Name	Robert T. Payne
Attorney Docket Number	24983US02

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☐ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Stephen M. Wurth/	Date (YYYY-MM-DD)	2014-04-15
Name/Print	Stephen M. Wurth	Registration Number	69796

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION CONCERNING TRANSMITTAL OF COPY OF INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY (CHAPTER I OF THE PATENT COOPERATION TREATY)
(PCT Rule 44bis.1(c))

To:

SHOOKMAN, Jeb, A.
McAndrews Held and Malloy
500 W. Madison, Suite 3400
Chicago, IL 60661
ETATS-UNIS D'AMERIQUE

Date of mailing *(day/month/year)* 28 November 2013 (28.11.2013)	
Applicant's or agent's file reference 24983WO01	IMPORTANT NOTICE

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US2012/038332	17 May 2012 (17.05.2012)	19 May 2011 (19.05.2011)

Applicant
METROM RAIL, LLC et al

The International Bureau transmits herewith a copy of the international preliminary report on patentability (Chapter I of the Patent Cooperation Treaty)

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No. +41 22 338 82 70

Authorized officer
Agnès Wittmann-Regis

e-mail: pt06.pct@wipo.int

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY
(Chapter I of the Patent Cooperation Treaty)

(PCT Rule 44*bis*)

Applicant's or agent's file reference 24983WO01	**FOR FURTHER ACTION**	See item 4 below
International application No. PCT/US2012/038332	International filing date *(day/month/year)* 17 May 2012 (17.05.2012)	Priority date *(day/month/year)* 19 May 2011 (19.05.2011)
International Patent Classification (8th edition unless older edition indicated) See relevant information in Form PCT/ISA/237		
Applicant METROM RAIL, LLC		

1. This international preliminary report on patentability (Chapter I) is issued by the International Bureau on behalf of the International Searching Authority under Rule 44 *bis*.1(a).

2. This REPORT consists of a total of 6 sheets, including this cover sheet.

   In the attached sheets, any reference to the written opinion of the International Searching Authority should be read as a reference to the international preliminary report on patentability (Chapter I) instead.

3. This report contains indications relating to the following items:

☒	Box No. I	Basis of the report
☐	Box No. II	Priority
☐	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
☐	Box No. IV	Lack of unity of invention
☒	Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
☐	Box No. VI	Certain documents cited
☐	Box No. VII	Certain defects in the international application
☐	Box No. VIII	Certain observations on the international application

4. The International Bureau will communicate this report to designated Offices in accordance with Rules 44*bis*.3(c) and 93*bis*.1 but not, except where the applicant makes an express request under Article 23(2), before the expiration of 30 months from the priority date (Rule 44*bis* .2).

	Date of issuance of this report 19 November 2013 (19.11.2013)
The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No. +41 22 338 82 70	Authorized officer Agnès Wittmann-Regis e-mail: pt06.pct@wipo.int

Form PCT/IB/373 (January 2004)

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To: JEB A. SHOOKMAN
MCANDREWS HELD AND MALLOY
500 W. MADISON, SUITE 3400
CHICAGO, IL 60661

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing *(day/month/year)*	13 JUL 2012
Applicant's or agent's file reference 24983WO01	**FOR FURTHER ACTION** See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US 12/38332	17 May 2012 (17.05.2012)	19 May 2011 (19.05.2011)

International Patent Classification (IPC) or both national classification and IPC
IPC(8) - G06F 17/10 (2012.01)
USPC - 701/301

Applicant METROM RAIL, LLC

1. This opinion contains indications relating to the following items:

- [X] Box No. I Basis of the opinion
- [ ] Box No. II Priority
- [ ] Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- [ ] Box No. IV Lack of unity of invention
- [X] Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- [ ] Box No. VI Certain documents cited
- [ ] Box No. VII Certain defects in the international application
- [ ] Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1 *bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to th IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Fom PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA/US	Date of completion of this opinion	Authorized officer:
Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	03 July 2012 (03.07.2012)	Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/237 (cover sheet) (July 2011)

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 12/38332

Box No. I Basis of this opinion

1. With regard to the **language**, this opinion has been established on the basis of:

   ☒ the international application in the language in which it was filed.

   ☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(a))

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing filed or furnished:

   a. (means)

      ☐ on paper

      ☐ in electronic form

   b. (time)

      ☐ in the international application as filed

      ☐ together with the international application in electronic form

      ☐ subsequently to this Authority for the purposes of search

4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 12/38332

Box No. V **Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Claims	11-12, 14-16	YES
	Claims	1-10, 13, 17-24	NO
Inventive step (IS)	Claims	None	YES
	Claims	1-24	NO
Industrial applicability (IA)	Claims	1-24	YES
	Claims	None	NO

2. Citations and explanations:

Claims 1-10, 13, and 17-24 lack novelty under PCT Article 33(2) as being anticipated by US 2008/0150786 A1 to Breed.

As to claim 1, Breed teaches a rail line vehicle having a vehicle mounted module, the vehicle mounted module comprising a transponder sensor module including an ultra wideband unit and a wireless communications antenna, wherein the ultra wideband unit is operable to detect a distance between the rail line vehicle and at least one other vehicle, wherein the wireless communications antenna is operable to send and receive data over the air ("Vehicle 18 contains two receivers 160,161 for the micropower impulse radar (MIR) implementation of the invention. MIR or ultrawideband (UWB) transmitter devices are placed at locations 151, 152 and 153 respectively," para [0183]); a control electronics module including a processor that is in communication with at least the ultra wideband unit ("A vehicle 246 includes an antenna 248 coupled to a control module, control unit, processor or computer 250. The antenna, which can be an imager, 248 receives transmissions (waves or wireless signals) including transmissions 252 when in range of the transmitters," para [0213]); and a user interface module including a user interface, wherein the user interface is operable to provide a vehicle operator with information and is operable to accept input from the vehicle operator ("a user input device on the vehicle which enables an occupant of the vehicle to request information to be transmitted via the transmitter," para [0366]).

As to claim 2, Breed teaches the rail line vehicle of claim 1 wherein the vehicle mounted module is in communication with one or more central tracking units by way of the wireless communications antenna, wherein the one or more central tracking units are operable to track the location of the rail line vehicle and at least one other vehicle ("communications with precise positioning stations for GPS independent location determination," para [0368]).

As to claim 3, Breed teaches the rail line vehicle of claim 1 wherein the vehicle mounted module further comprises a central tracking unit module that is operable to track the location of at least one other vehicle (" management of the database may include transmitting from the vehicle requests, for example, to other vehicles, a central map management facility or infrastructure, to ascertain whether the database has current map data for the current location of the vehicle and surrounding locations," para [0155]; "The system described herein also permits better simultaneous tracking of several vehicles," para [0309]).

As to claim 4, Breed teaches the rail line vehicle of claim 1 wherein the transponder sensor module further includes a global positioning system, wherein the global positioning system is operable to receive information from one or more satellites and is operable to determine the absolute position of the rail line vehicle ("initially, it is preferred to use the GPS navigational satellites as the base technology," para [0159]).

As to claim 5, Breed teaches the rail line vehicle of claim 4 wherein the vehicle mounted module is operable to utilize information generated by the global positioning system and the ultra wideband unit to determine whether one or more vehicle separation criteria are violated, and generate a warning if one or more vehicle separation criteria are violated ("the extraction of information from radio frequency wave transmission may be limited based on a threshold determination (a filter of sorts) as to whether the transmission is of potential interest, e.g., to the operation of the vehicle based on its position, location and/or motion," para [0214]; "Other reactive systems 265 are also envisioned, e.g., a warning system to warn the driver of the vehicle about the presence of another vehicle within a threshold distance form the vehicle," para [0272]).

As to claim 6, Breed teaches the rail line vehicle of claim 1 wherein the user interface module further includes a service interface operable to allow the vehicle operator to configure, calibrate, service, maintain, diagnose, update and/or install information on vehicle mounted module ("calibration system," para [0200]; "the diagnostic or prognostic determination is transmitted from the vehicle to a transmitter which in turn can direct the determination to a dealer, manufacturer, vehicle owner and/or service center," para [0368]; "diagnostic and prognostic telematics communications," para [0397]).

As to claim 7, Breed teaches the rail line vehicle of claim 1 wherein the control electronics module further includes one or more interfaces that are operable to communicate with ground speed detection modules ("ground speed monitoring system using lasers, radar or ultrasonics," para [0502]).

As to claim 8, Breed teaches the rail line vehicle of claim 7 wherein the ground speed detection modules include one or more of a microwave radar, a laser device, an infrared sensor and an ultra wideband sensor (para [0502]).

(PLEASE SEE SUPPLEMENTAL BOX)

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 12/38332

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:
Box V.2 - Citations and explanations:

As to claim 9, Breed teaches the rail line vehicle of claim 1 wherein the control electronics module further includes one or more inertial measurement units ("The inertial navigation system (INS), sometimes called the inertial reference unit or IRU, comprises one or more accelerometers 78 and one or more gyroscopes," para [0503]).

As to claim 10, Breed teaches the rail line vehicle of claim 1 wherein the vehicle mounted modules comprises one or more additional transponder sensor modules, wherein the vehicle mounted module is operable to accept calibration information regarding the length of the rail line vehicle and the mounting locations of the transponder sensor module and the one or more additional transponder sensor modules ("Extension assembly 214 can include a mounting bracket 216 from the roof of the vehicle 200 forward to each data acquisition module 210, a mounting bracket 218 extending from the front bumper upward to each data acquisition module 202 and a cross mounting bracket 220 extending between the data acquisition modules 202 for support. Since all of the data acquisition equipment is co-located, its precise location is accurately determined by the IMU, the mounting location on the vehicle and the differential GPS system," para [0139]).

As to claim 13, Breed teaches the rail line vehicle of claim 1 wherein the transponder sensor module further includes one or more of a laser device, a radar sensor and an infrared sensor (para [0502]).

As to claim 17, Breed teaches the rail line vehicle of claim 1 wherein the vehicle mounted module is operable to utilize a stopping distance calibration feature that measures a stopping distance, wherein the stopping distance indicates how quickly the rail line vehicle can stop under current conditions ("Range-gating on the imaging system or reflection measurements on the laser radar units can be used to measure the driver's sight distance and the speed of the vehicle can then be limited to a speed that allows for a safe stopping distance between the vehicle and another vehicle or object that may be in the path of the vehicle or on a collision path with the vehicle," para [0272]).

As to claim 18, Breed teaches the rail line vehicle of claim 17 wherein the measured stopping distance is used to modify one or more safe separation distance thresholds ("if a faster moving vehicle approaches a slower moving vehicle, it will automatically slow down to keep a safe separation distance from the leading, slower moving vehicle," para [0078]).

As to claim 19, Breed teaches the rail line vehicle of claim 1 wherein the control electronics module further includes an inertial measurement unit (para [0503]).

As to claim 20, Breed teaches a collision avoidance system comprising: one or more vehicle mounted modules, each mounted on a vehicle, each vehicle mounted module comprising: a transponder sensor module including an ultra wideband unit and a wireless communications antenna, wherein the ultra wideband unit is operable to detect a distance between the vehicle on which the vehicle mounted module is mounted and at least one other vehicle, wherein the wireless communications antenna is operable to send and receive data over the air (para [0183]); a control electronics module including a processor that is in communication with at least the ultra wideband unit (para [0213]); and a user interface module including a user interface, wherein the user interface is operable to provide a vehicle operator with information and is operable to accept input from the vehicle operator (para [0366]); and a central tracking unit that is in communication with the one or more vehicle mounted modules, the central tracking unit being operable to track the location of the one or more vehicle mounted modules (para [0368]).

As to claim 21, Breed teaches the collision avoidance system of claim 20 wherein the central tracking unit is distributed among the one or more vehicle mounted modules, wherein each of the one or more vehicle mounted modules includes a central tracking unit component, each central tracking unit component is in communication with the vehicle's control electronics module (para [0135], [0139]).

As to claim 22, Breed teaches the collision avoidance system of claim 20 wherein the central tracking unit is disposed in a discrete housing ("Such a device typically has three accelerometers and three gyroscopes that are held together in a single housing," para [0114]).

As to claim 23, Breed teaches the collision avoidance system of claim 20 wherein the transponder sensor module further includes a global positioning system, wherein the global positioning system is operable to receive information from one or more satellites and is operable to determine the absolute position of the vehicle mounted module (para [0135]).

As to claim 24, Breed teaches the collision avoidance system of claim 20 wherein each vehicle mounted module is operable to utilize information generated by the global positioning system, the ultra wideband unit and the central tracking unit to determine whether one or more vehicle separation criteria are violated, and generate a warning if one or more vehicle separation criteria are violated (para [0214], [0272]).

(PLEASE SEE NEXT SUPPLEMENTAL BOX)

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 12/38332

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:
Box V.2 - Citations and explanations:

Claims 11-12 and 14 lack an inventive step under PCT Article 33(3) as being obvious over Breed in view of US 2006/0025897 A1 to Shostak et al. (hereinafter 'Shostak').

As to claim 11, Breed teaches the rail line vehicle of claim 1 but fails to explicitly teach such a vehicle wherein the vehicle mounted modules comprises an additional ultra wideband unit, wherein an offset exists between the ultra wideband unit and the additional ultra wideband unit once the two units are mounted on the rail line vehicle. However, Shostak teaches such a vehicle wherein the vehicle mounted modules comprises an additional ultra wideband unit, wherein an offset exists between the ultra wideband unit and the additional ultra wideband unit once the two units are mounted on the rail line vehicle ("Another method is to offset the antenna array, as illustrated in FIG. 21, so that the returns naturally are spaced in time," para [0916]). It would have been obvious to one of ordinary skill in the art to combine the rail line vehicle system of Breed with the support for wideband offsets of Shostak, because Breed and Shostak are directed to systems and methods for ultra wideband transponders used for vehicle sensors. Furthermore, users benefit from systems and methods adapted for wideband offsets, because such systems and methods allow for naturally spacing signals from ultra wideband transponders in time (para [0916]).

As to claim 12, Breed teaches the rail line vehicle of claim 1 but fails to explicitly teach such a vehicle wherein the ultra wideband unit is adapted to transmit and receive signals with varying center frequencies. However, Shostak teaches such a vehicle wherein the ultra wideband unit is adapted to transmit and receive signals with varying center frequencies ("the center frequency of the UWB transceiver could be hopped or swept simultaneously," para [0979]). It would have been obvious to one of ordinary skill in the art to combine the rail line vehicle system of Breed with the support for varying center frequencies of Shostak, because Breed and Shostak are directed to systems and methods for ultra wideband transponders used for vehicle sensors. Furthermore, users benefit from systems and methods adapted for varying center frequencies, because such systems and methods allow for multiple antennas (para [0979]-[0980]).

As to claim 14, Breed teaches the rail line vehicle of claim 1 but fails to explicitly teach such a vehicle wherein the user interface is a touchscreen including a screen, the touchscreen being operable to display one or more screens, menus, options and/or functions, and accept user input from the vehicle operator by allowing the vehicle operator to touch the screen of the touchscreen. However, Shostak teaches such a vehicle wherein the user interface is a touchscreen including a screen, the touchscreen being operable to display one or more screens, menus, options and/or functions, and accept user input from the vehicle operator by allowing the vehicle operator to touch the screen of the touchscreen (para [1555]). It would have been obvious to one of ordinary skill in the art to combine the rail line vehicle system of Breed with the support for touchscreens of Shostak, because Breed and Shostak are directed to systems and methods for interfaces used with vehicle sensors. Furthermore, users benefit from systems and methods adapted for touchscreens, because such systems and methods allow for touch interfaces for a wide variety of sensors (para [1555]).

Claims 15-16 lack an inventive step under PCT Article 33(3) as being obvious over Breed in view of US 2010/0207787 A1 to Catten et al. (hereinafter 'Catten').

As to claim 15, Breed teaches the rail line vehicle of claim 1 but fails to explicitly teach such a vehicle wherein the vehicle mounted module is operable to utilize a progressive warning feature that generates a warning if one or more vehicle separation thresholds are violated, wherein the rate, frequency, prominence and/or severity of the warning increases as the violation of the vehicle separation threshold becomes more critical. However, Catten teaches such a vehicle wherein the vehicle mounted module is operable to utilize a progressive warning feature that generates a warning if one or more vehicle separation thresholds are violated, wherein the rate, frequency, prominence and/or severity of the warning increases as the violation of the vehicle separation threshold becomes more critical ("the vehicle monitoring system may present single or multiple warnings or alerts to the driver both in increasing frequency and/or pitch, and/or light intensity," para [0050]). It would have been obvious to one of ordinary skill in the art to combine the rail line vehicle system of Breed with the support for increasing alert frequency of Catten, because Breed and Catten are directed to systems and methods for proximity alerts using vehicle sensors. Furthermore, users benefit from systems and methods adapted for increasing alert frequency, because such systems and methods allow for providing a changing alert to a driver based on travel conditions (para [0050]).

As to claim 16, Catten teaches the rail line vehicle of claim 15 wherein the progressive warning feature utilizes an adaptive threshold feature that modifies the one or more vehicle separation thresholds based on the speed of the rail line vehicle and the speed of one or more nearby vehicles ("the parameters used to evaluate driver behavior may be modified based upon road conditions. Additionally, the driver may be evaluated based upon his reaction to changes in road conditions and his response to warnings of changing road conditions. The monitoring levels that are set in the vehicle monitoring system may be configured to be adjusted based upon road conditions," para [0061]).

Claims 1-24 have industrial applicability as defined by PCT Article 33(4), because the subject matter can be made or used in industry.

Electronic Acknowledgement Receipt

EFS ID:	18765981
Application Number:	13474428
International Application Number:	
Confirmation Number:	6724
Title of Invention:	COLLISION AVOIDANCE SYSTEM FOR RAIL LINE VEHICLES
First Named Inventor/Applicant Name:	Richard C. Carlson
Customer Number:	23446
Filer:	Stephen M. Wurth/Julia Villarreal
Filer Authorized By:	Stephen M. Wurth
Attorney Docket Number:	24983US02
Receipt Date:	15-APR-2014
Filing Date:	17-MAY-2012
Time Stamp:	13:56:14
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	24983US02_IDS_sb08a_EFS_4_15_2014.pdf	612320 bda51e62d1d6c02ff8e4cc8f61bbb927a1eba477	no	4

Warnings:	
Information:	

A U.S. Patent Number Citation or a U.S. Publication Number Citation is required in the Information Disclosure Statement (IDS) form for autoloading of data into USPTO systems. You may remove the form to add the required data in order to correct the Informational Message if you are citing U.S. References. If you chose not to include U.S. References, the image of the form will be processed and be made available within the Image File Wrapper (IFW) system. However, no data will be extracted from this form. Any additional data such as Foreign Patent Documents or Non Patent Literature will be manually reviewed and keyed into USPTO systems.

2	Non Patent Literature	01NPL_IPRP.pdf	591997 fa2f3a5ad9a424eea410babc8028b37cf3c5923d	no	7

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Total Files Size (in bytes):	1204317

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New Applications Under 35 U.S.C. 111

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PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
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P.O. Box 1450
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CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

23446 7590 01/17/2014
MCANDREWS HELD & MALLOY, LTD
500 WEST MADISON STREET
SUITE 3400
CHICAGO, IL 60661

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Stephen M. Wurth	(Depositor's name)
/Stephen M. Wurth/	(Signature)
April 15, 2014	(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/474,428	05/17/2012	Richard C. Carlson	24983US02	6724

TITLE OF INVENTION: COLLISION AVOIDANCE SYSTEM FOR RAIL LINE VEHICLES

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$480	$0	$0	$480	04/17/2014

EXAMINER	ART UNIT	CLASS-SUBCLASS
PAYNE, ROBERT T	3661	701-301000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list

(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,

(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 McAndrews, Held & Malloy, Ltd.
2
3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

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(A) NAME OF ASSIGNEE	(B) RESIDENCE: (CITY and STATE OR COUNTRY)
Metrom Rail, LLC	Lake Zurich, IL

Please check the appropriate assignee category or categories (will not be printed on the patent) : ☐ Individual ☒ Corporation or other private group entity ☐ Government

4a. The following fee(s) are submitted:

☒ Issue Fee

☐ Publication Fee (No small entity discount permitted)

☐ Advance Order - # of Copies _____

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☐ A check is enclosed.

☒ Payment by credit card. Form PTO-2038 is attached.

☒ The Director is hereby authorized to charge the required fee(s), any deficiency, or credits any overpayment, to Deposit Account Number 130017 (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)

☐ Applicant certifying micro entity status. See 37 CFR 1.29

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

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NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature /Stephen M. Wurth/ Date April 15, 2014

Typed or printed name Stephen M. Wurth Registration No. 69796

Electronic Patent Application Fee Transmittal

Application Number:	13474428
Filing Date:	17-May-2012
Title of Invention:	COLLISION AVOIDANCE SYSTEM FOR RAIL LINE VEHICLES
First Named Inventor/Applicant Name:	Richard C. Carlson
Filer:	Stephen M. Wurth/Julia Villarreal
Attorney Docket Number:	24983US02

Filed as Small Entity

Utility under 35 USC 111(a) Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Utility Appl Issue Fee	2501	1	480	480
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
			Total in USD ($)	**480**

Electronic Acknowledgement Receipt

EFS ID:	18783898
Application Number:	13474428
International Application Number:	
Confirmation Number:	6724
Title of Invention:	COLLISION AVOIDANCE SYSTEM FOR RAIL LINE VEHICLES
First Named Inventor/Applicant Name:	Richard C. Carlson
Customer Number:	23446
Filer:	Stephen M. Wurth/Julia Villarreal
Filer Authorized By:	Stephen M. Wurth
Attorney Docket Number:	24983US02
Receipt Date:	16-APR-2014
Filing Date:	17-MAY-2012
Time Stamp:	17:35:37
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$480
RAM confirmation Number	6721
Deposit Account	130017
Authorized User	WURTH, STEPHEN M

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Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Issue Fee Payment (PTO-85B)	24983US02_Part_B_Fee_Transmittal.pdf	633427 c9e5eca028eb0c2dcf9e184f462db0799c30cbe1	no	1
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30117 11f64f38548dcb3b645c596924c403ea086231a0	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	663544		

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New Applications Under 35 U.S.C. 111
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Stephen M. Wurth	(Depositor's name)
/Stephen M. Wurth/	(Signature)
April 16, 2014	(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/474,428	05/17/2012	Richard C. Carlson	24983US02	6724

TITLE OF INVENTION: COLLISION AVOIDANCE SYSTEM FOR RAIL LINE VEHICLES

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
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PAYNE, ROBERT T	3661	701-301000

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Metrom Rail, LLC	Lake Zurich, IL

Please check the appropriate assignee category or categories (will not be printed on the patent) : ☐ Individual ☒ Corporation or other private group entity ☐ Government

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☐ Publication Fee (No small entity discount permitted)

☐ Advance Order - # of Copies _____

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Authorized Signature /Stephen M. Wurth/ Date April 16, 2014

Typed or printed name Stephen M. Wurth Registration No. 69796

Electronic Acknowledgement Receipt

EFS ID:	18784164
Application Number:	13474428
International Application Number:	
Confirmation Number:	6724
Title of Invention:	COLLISION AVOIDANCE SYSTEM FOR RAIL LINE VEHICLES
First Named Inventor/Applicant Name:	Richard C. Carlson
Customer Number:	23446
Filer:	Stephen M. Wurth/Julia Villarreal
Filer Authorized By:	Stephen M. Wurth
Attorney Docket Number:	24983US02
Receipt Date:	16-APR-2014
Filing Date:	17-MAY-2012
Time Stamp:	17:50:32
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Issue Fee Payment (PTO-85B)	24983US02_Part_B_Fee_Transmittal.pdf	633700 ea73cd8189524b6e2a25b19880026a440176af84	no	1

Warnings:	
Information:	

Total Files Size (in bytes):	633700

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CHICAGO, IL 60661

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/Stephen M. Wurth/	(Signature)
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EXAMINER	ART UNIT	CLASS-SUBCLASS
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1 McAndrews, Held & Malloy, Ltd.
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(A) NAME OF ASSIGNEE: Metrom Rail, LLC

(B) RESIDENCE: (CITY and STATE OR COUNTRY): Lake Zurich, IL

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- ☐ Publication Fee (No small entity discount permitted)
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Authorized Signature /Stephen M. Wurth/ Date April 15, 2014

Typed or printed name Stephen M. Wurth Registration No. _____

04/17/2014 INTEFSW 00006721 13474428
69796
01 FC:2501 480.00 OP

PTOL-85 Part B (10-13) Approved for use through 10/31/2013. OMB 0651-0033 U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/474,428	05/17/2012	Richard C. Carlson	24983US02	6724

7590 04/23/2014

MCANDREWS HELD & MALLOY, LTD
500 WEST MADISON STREET
SUITE 3400
CHICAGO, IL 60661

EXAMINER	
PAYNE, ROBERT T	

ART UNIT	PAPER NUMBER
3661	

NOTIFICATION DATE	DELIVERY MODE
04/23/2014	ELECTRONIC

NOTICE OF NON-COMPLIANT INFORMATION DISCLOSURE STATEMENT

An Information Disclosure Statement (IDS) filed 04-15-14 in the above-identified application fails to meet the requirements of 37 CFR 1.97(d) for the reason(s) specified below. Accordingly, the IDS will be placed in the file, but the information referred to therein has not been considered.

The IDS is not compliant with 37 CFR 1.97(d) because:

☒ The IDS lacks a statement as specified in 37 CFR 1.97(e).

☐ The IDS lacks the fee set forth in 37 CFR 1.17(p).

☐ The IDS was filed after the issue fee was paid. Applicant may wish to consider filing a petition to withdraw the application from issue under 37 CFR 1.313(c) to have the IDS considered. See MPEP 1308.

Almaz Gebresenbet for

571-272-4200 or 1-888-786-0101
Application Assistance Unit
Office of Data Management

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	13474428	CARLSON ET AL.
	Examiner	**Art Unit**
	ROBERT PAYNE	3661

CPC							
Symbol						**Type**	**Version**
B61L		23	/	06		I	2013-01-01
B61L		2205	/	04		A	2013-01-01
B61L		15	/	0027		F	2013-01-01
G08G		1	/	166		I	2013-01-01
B61L		25	/	025		I	2013-01-01
G08G		1	/	161		I	2013-01-01
B61L		23	/	34		I	2013-01-01
			/				
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			/				
			/				

CPC Combination Sets								
Symbol					**Type**	**Set**	**Ranking**	**Version**
			/					
			/					

/ROBERT PAYNE/ Examiner.Art Unit 3661	1/13/2014	**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	28	
/THOMAS BLACK/ Supervisory Patent Examiner.Art Unit 3661	01/13/2014	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	13474428	CARLSON ET AL.
	Examiner	**Art Unit**
	ROBERT PAYNE	3661

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**
701	301

CROSS REFERENCE(S)					
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**				
701	300				

INTERNATIONAL CLASSIFICATION					
CLAIMED					**NON-CLAIMED**
G	0	5	D	1 / 02 (2006.01.01)	
G	0	6	F	17 / 10 (2006.01.01)	
G	0	6	G	7 / 78 (2006.01.01)	

/ROBERT PAYNE/ Examiner.Art Unit 3661	1/13/2014	**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	28	
/THOMAS BLACK/ Supervisory Patent Examiner.Art Unit 3661	01/13/2014	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	13474428	CARLSON ET AL.
	Examiner	**Art Unit**
	ROBERT PAYNE	3661

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
	1		17	9	33	25	49								
	2		18	10	34	26	50								
	3		19	11	35	27	51								
	4		20	12	36	28	52								
	5		21	13	37										
	6		22	14	38										
	7		23	15	39										
	8		24	16	40										
	9	1	25	17	41										
	10	2	26	18	42										
	11	3	27	19	43										
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	13	5	29	21	45										
	14	6	30	22	46										
	15	7	31	23	47										
	16	8	32	24	48										

/ROBERT PAYNE/ Examiner.Art Unit 3661 (Assistant Examiner)	1/13/2014 (Date)	**Total Claims Allowed:** 28	
/THOMAS BLACK/ Supervisory Patent Examiner.Art Unit 3661 (Primary Examiner)	01/13/2014 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 1

PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	13474428
Filing Date	2012-05-17
First Named Inventor	Richard C. Carlson
Art Unit	3661
Examiner Name	Robert T. Payne
Attorney Docket Number	24983US02

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
/R.P./	1	20080150786		2008-06-26	Breed	
/R.P./	2	20060025897		2006-07-30	Shostak	
/R.P./	3	20100207787		2010-08-19	Catten	

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1							☐

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /R.P./

Receipt date: 02/20/2014	Application Number	13474428	13474428 - GAU: 3661
INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Filing Date	2012-05-17	
	First Named Inventor	Richard C. Carlson	
	Art Unit	3661	
	Examiner Name	Robert T. Payne	
	Attorney Docket Number	24983US02	

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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1	PCT Notification Concerning Transmittal of Copy of International Preliminary Report on Patentability in International applciation no. PCT/US2012/038332, dated November 28, 2013. (7 pages).	☐

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EXAMINER SIGNATURE

Examiner Signature	/Robert Payne/	Date Considered	06/05/2014

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

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Receipt date: 02/20/2014	Application Number	13474428	13474428 - GAU: 3661
INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Filing Date	2012-05-17	
	First Named Inventor	Richard C. Carlson	
	Art Unit	3661	
	Examiner Name	Robert T. Payne	
	Attorney Docket Number	24983US02	

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☒ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☒ Fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☐ None

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Michael J. Krautner/	Date (YYYY-MM-DD)	2014-02-20
Name/Print	Michael J. Krautner	Registration Number	59,218

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

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7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

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(Not for submission under 37 CFR 1.99)

Application Number	13474428
Filing Date	2012-05-17
First Named Inventor	Richard C. Carlson
Art Unit	3661
Examiner Name	Robert T. Payne
Attorney Docket Number	24983US02

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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
/R.P./	1	20080150786		2008-06-26	Breed	
/R.P./	2	20060025897		2006-02-02 ~~2006-07-30~~	Shostak	
/R.P./	3	20100207787		2010-08-19	Catten	

Change(s) applied to document, /J.H./ 7/25/2014

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
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APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/474,428	08/19/2014	8812227	24983US02	6724

23446 7590 07/30/2014

MCANDREWS HELD & MALLOY, LTD
500 WEST MADISON STREET
SUITE 3400
CHICAGO, IL 60661

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 0 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

Richard C. Carlson, Wauconda, IL;
Kurt A. Gunther, Round Lake Heights, IL;
Marc W. Cygnus, Mundelein, IL;

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PATENT ASSIGNMENT COVER SHEET

Electronic Version v1.1
Stylesheet Version v1.2

EPAS ID: PAT3561999

SUBMISSION TYPE:	CORRECTIVE ASSIGNMENT
NATURE OF CONVEYANCE:	Corrective Assignment to correct the NATURE OF CONVEYANCE SECTION SHOULD INCLUDE REEL/FRAME NUMBER OF 031398/0349 previously recorded on Reel 031398 Frame 0349. Assignor(s) hereby confirms the ORIGINALLY STATED SUBMISSION OF CORRECTED INFORMATION IN ACCORDANCE WITH MPEP 323.01(C) WITHOUT REEL/FRAME NUMBER.

CONVEYING PARTY DATA

Name	Execution Date
KURT A GUNTHER	05/20/2010
RICHARD C. CARLSON	05/20/2010
MARC W. CYGNUS	05/20/2010

RECEIVING PARTY DATA

Name:	METROM RAIL, LLC
Street Address:	244 TELSER ROAD
City:	LAKE ZURICH
State/Country:	ILLINOIS
Postal Code:	60047

PROPERTY NUMBERS Total: 1

Property Type	Number
Application Number:	13474428

CORRESPONDENCE DATA

Fax Number: (312)775-8100

Correspondence will be sent to the e-mail address first; if that is unsuccessful, it will be sent using a fax number, if provided; if that is unsuccessful, it will be sent via US Mail.

Phone: 3127758000
Email: mhmpto@mcandrews-ip.com
Correspondent Name: MCANDREWS HELD & MALLOY LTD.
Address Line 1: 500 WEST MADISON STREET
Address Line 2: 34TH FLOOR
Address Line 4: CHICAGO, ILLINOIS 60661

ATTORNEY DOCKET NUMBER:	76724US01
NAME OF SUBMITTER:	MALAIKA O.D. TYSON
SIGNATURE:	/Malaika O.D. Tyson/
DATE SIGNED:	10/08/2015

	This document serves as an Oath/Declaration (37 CFR 1.63).

Total Attachments: 19

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McAndrews, Held & Malloy

503347851 06/12/2015

PATENT ASSIGNMENT COVER SHEET

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EPAS ID: PAT3394471

SUBMISSION TYPE:	NEW ASSIGNMENT
NATURE OF CONVEYANCE:	SUBMISSION OF CORRECTED INFORMATION IN ACCORDANCE WITH MPEP 323.01(C)

CONVEYING PARTY DATA

Name	Execution Date
JAMES A. MARCHI	06/10/2015

RECEIVING PARTY DATA

Name:	METROM RAIL, LLC
Street Address:	244 TELSER ROAD
City:	LAKE ZURICH
State/Country:	ILLINOIS
Postal Code:	60047

PROPERTY NUMBERS Total: 1

Property Type	Number
Application Number:	13474428

CORRESPONDENCE DATA

Fax Number: (312)775-8100

Correspondence will be sent to the e-mail address first; if that is unsuccessful, it will be sent using a fax number, if provided; if that is unsuccessful, it will be sent via US Mail.

Phone: 3127758000
Email: mhmpto@mcandrews-ip.com
Correspondent Name: MCANDREWS HELD & MALLOY, LTD.
Address Line 1: 500 WEST MADISON STREET
Address Line 2: 34TH FLOOR
Address Line 4: CHICAGO, ILLINOIS 60661

ATTORNEY DOCKET NUMBER:	76724US01
NAME OF SUBMITTER:	MALAIKA O.D. TYSON
SIGNATURE:	/Malaika O.D. Tyson/
DATE SIGNED:	06/12/2015

Total Attachments: 15
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SUBMISSION TYPE:	NEW ASSIGNMENT
NATURE OF CONVEYANCE:	SUBMISSION OF CORRECTED INFORMATION IN ACCORDANCE WITH MPEP 323.01(C)

CONVEYING PARTY DATA

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JAMES A. MARCHI	06/10/2015

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Correspondent Name: MCANDREWS HELD & MALLOY, LTD.
Address Line 1: 500 WEST MADISON STREET
Address Line 2: 34TH FLOOR
Address Line 4: CHICAGO, ILLINOIS 60661

ATTORNEY DOCKET NUMBER:	76724US01
NAME OF SUBMITTER:	MALAIKA O.D. TYSON
Signature:	/Malaika O.D. Tyson/
Date:	06/12/2015

Total Attachments: 15
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RECEIPT INFORMATION

EPAS ID: PAT3394471
Receipt Date: 06/12/2015

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Attorney Docket No.: 03641 - 76724US01

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In the Application of:

Richard C. Carlson et al.

Serial No.: 13/474,428

Filed: May 17, 2012

For: COLLISION AVOIDANCE SYSTEM FOR RAIL LINE VEHICLES

SUBMISSION OF CORRECTED INFORMATION IN ACCORDANCE WITH MPEP 323.01(C)

Attention: Assignment Services Division
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Assignment Services Personnel:

Assignee Metrom Rail, LLC (Metrom Rail) has determined that another party has improperly recorded a lien against Serial Number 13/474,428. The purpose of this filing is to correct the record.

Pursuant to MPEP 323.01(c), Assignee submits the following:

1) A completed cover sheet identifying the patent against which the lien was improperly recorded;
2) A declaration (1) identifying Metrom Rail as the correct owner, (2) stating that the previously recorded document was submitted with erroneous information, and (3) providing the reel and frame number of the previously recorded document; and
3) the required fee (37 CFR 3.41) for each application or patent to be corrected.

The Commissioner is authorized to charge any additional fees or credit any overpayment to the Deposit Account of McAndrews, Held & Malloy, Account No. 13-0017.

Dated: June 12, 2015

Respectfully submitted,

/Malaika O.D. Tyson #68,455/
Malaika O. D. Tyson
Reg. No. 68,455

McAndrews, Held & Malloy, Ltd.
500 West Madison Street
34th Floor
Chicago, IL 60661
Telephone: (312) 775-8000
Facsimile: (312) 775-8100

DECLARATION OF JAMES A. MARCHI SUBMITTED IN ACCORDANCE WITH MPEP 323.01(C)

I, James A. Marchi, declare as follows:

1. I am the sole managing member of Metrom Rail, LLC, an Illinois limited liability company ("Metrom Rail").

2. I am over eighteen years of age and am fully competent to make this Declaration. This Declaration is based on my personal knowledge.

3. Metrom Rail is the true and correct owner of U.S. Patent Nos. 8,812,227 (U.S. Application Ser. No. 13/474,428) and 8,752,797 (U.S. Application Ser. No. 13/310,006) and U.S. Application Ser. Nos. 13/644,737 and 13/855,118, free and clear of any liens and encumbrances. In paragraphs 4-37, I summarize the true chain of title for each of these patents and applications. In paragraphs 38-44, I describe a lien that was erroneously recorded against each of these patents and applications.

Chain of Title Summary for U.S. Application Ser. No. 13/474,428

4. On May 17, 2012, the three inventors for U.S. Application Ser. No. 13/474,428 assigned their interest in the application to Metrom Rail. I understand that these assignment documents were recorded with the U.S. Patent and Trademark Office at Reel: 28233 Frame: 175-79 on May 17, 2012.

5. On August 7, 2013, Metrom Rail granted a security interest in U.S. Application Ser. No. 13/474,428 to Mark Strauch. I understand that these assignment

documents were recorded with the U.S. Patent and Trademark Office at Reel: 30993 Frame: 990-96 on August 8, 2013. On January 2, 2015, a UCC financing statement amendment terminating the Strauch security interest was filed with the Illinois Secretary of State. I understand that this amendment was recorded with the U.S. Patent and Trademark Office at Reel: 35122 Frame:276-77 on March 3, 2015.

6. Metrom Rail granted a security interest in U.S. Application Ser. No. 13/474,428 to KMAM, LLC. On December 31, 2013, a UCC financing statement was filed with the Illinois Secretary of State with respect to KMAM's security interest in U.S. Application Ser. No. 13/474,428. On January 2, 2015, a UCC financing statement amendment terminating the KMAM, LLC security interest was filed with the Illinois Secretary of State. I understand that this amendment was recorded with the U.S. Patent and Trademark Office at Reel:35078 Frame:841-42 on March 3, 2015.

7. Metrom Rail granted security interests in U.S. Application Ser. No. 13/474,428 to Mark Faber. On July 25, 2013, a UCC financing statement was filed with the Illinois Secretary of State with respect to Faber's first security interest in U.S. Application Ser. No. 13/474,428. On January 2, 2015, a UCC financing statement amendment terminating the first Faber security interest was filed with the Illinois Secretary of State. I understand that this amendment was recorded with the U.S. Patent and Trademark Office at Reel: 35122 Frame:103-04 on March 3, 2015.

8. On July 25, 2013, a UCC financing statement was filed with the Illinois Secretary of State with respect to Faber's second security interest in U.S. Application Ser. No. 13/474,428. On January 2, 2015, a UCC financing statement amendment terminating the second Faber security interest was filed with the Illinois Secretary of State. I understand that this amendment was recorded with the U.S. Patent and Trademark Office at Reel: 35122 Frame:128-29 on March 3, 2015.

9. On August 23, 2013, a UCC financing statement was filed with the Illinois Secretary of State with respect to Faber's third security interest in U.S. Application Ser. No. 13/474,428. On January 2, 2015, a UCC financing statement amendment terminating the third Faber security interest was filed with the Illinois Secretary of State. I understand that this amendment was recorded with the U.S. Patent and Trademark Office at Reel: 35122 Frame: 144-45 on March 3, 2015.

10. Several other security interests were granted in U.S. Application Ser. No. 13/474,428. None of these security interests were recorded with the U.S. Patent and Trademark Office. All of these security interests have since been terminated.

11. As such Metrom Rail is the true and correct owner of U.S. Application Ser. No. 13/474,428 free and clear of any liens and encumbrances.

Chain of Title Summary for U.S. Application Ser. No. 13/310,006

12. On April 27, 2012, the four inventors for U.S. Application Ser. No. 13/310,006 assigned their interest in the application to Metrom Rail. I understand that these

assignment documents are recorded with the U.S. Patent and Trademark Office at Reel: 28233 Frame:196-202.

13. On August 7, 2013 a security interest was executed by which Metrom Rail assigned an interest in U.S. Application Ser. No. 13/310,006 to Mark Strauch. I understand that these assignment documents were recorded with the U.S. Patent and Trademark Office at Reel: 30993 Frame: 990-96 on August 8, 2013. On January 2, 2015, a UCC financing statement amendment terminating the Strauch security interest was filed with the Illinois Secretary of State. I understand that this amendment was recorded with the U.S. Patent and Trademark Office at Reel:35122 Frame:150-51 on March 3, 2015.

14. Metrom Rail granted a security interest in U.S. Application Ser. No. 13/310,006 to KMAM, LLC. On December 31, 2013, a UCC financing statement was filed with the Illinois Secretary of State with respect to KMAM's security interest in U.S. Application Ser. No. 13/310,006. On January 2, 2015, a UCC financing statement amendment terminating the KMAM, LLC security interest was filed with the Illinois Secretary of State. I understand that this amendment was recorded with the U.S. Patent and Trademark Office at Reel:35078 Frame:830-31 on March 3, 2015.

15. Metrom Rail granted security interests in U.S. Application Ser. No. 13/310,006 to Mark Faber. On July 25, 2013, a UCC financing statement was filed with the Illinois Secretary of State with respect to Faber's first security interest in U.S.

Application Ser. No. 13/310,006. On January 2, 2015, a UCC financing statement amendment terminating the first Faber security interest was filed with the Illinois Secretary of State. I understand that this amendment was recorded with the U.S. Patent and Trademark Office at Reel: 35122 Frame:111-12 on March 3, 2015.

16. On July 25, 2013, a UCC financing statement was filed with the Illinois Secretary of State with respect to Faber's second security interest in U.S. Application Ser. No. 13/310,006. On January 2, 2015, a UCC financing statement amendment terminating the second Faber security interest was filed with the Illinois Secretary of State. I understand that this amendment was recorded with the U.S. Patent and Trademark Office at Reel: 35122 Frame:126-27 on March 3, 2015.

17. On August 23, 2013, a UCC financing statement was filed with the Illinois Secretary of State with respect to Faber's third security interest in U.S. Application Ser. No. 13/310,006. On January 2, 2015, a UCC financing statement amendment terminating the third Faber security interest was filed with the Illinois Secretary of State. I understand that this amendment was recorded with the U.S. Patent and Trademark Office at Reel: 35122 Frame: 134-35 on March 3, 2015.

18. Several other security interests were granted in U.S. Application Ser. No. 13/310,006. None of these security interests were recorded with the U.S. Patent and Trademark Office. All of these security interests have since been terminated.

19. As such Metrom Rail is the true and correct owner of U.S. Application Ser. No. 13/310,006 free and clear of any liens and encumbrances.

Chain of Title Summary for U.S. Application Ser. No. 13/855,118

20. On April 12, 2013, the four inventors for U.S. Application Ser. No. 13/855,118 assigned their interest in the application to Metrom Rail. I understand that these assignment documents are recorded with the U.S. Patent and Trademark Office at Reel: 30347 Frame: 679-86.

21. Metrom Rail granted a security interest in U.S. Application Ser. No. 13/855,118 to Mark Strauch. On March 4, 2013, a UCC financing statement was filed with the Illinois Secretary of State with respect to Strauch's security interest in U.S. Application Ser. No. 13/855,118. On January 2, 2015, a UCC financing statement amendment terminating the Strauch security interest was filed with the Illinois Secretary of State. I understand that this amendment was recorded with the U.S. Patent and Trademark Office at Reel:35122 Frame:181-82 on March 3, 2015.

22. Metrom Rail granted a security interest in U.S. Application Ser. No. 13/855,118 to KMAM, LLC. On December 31, 2013, a UCC financing statement was filed with the Illinois Secretary of State with respect to KMAM's security interest in U.S. Application Ser. No. 13/855,118. On January 2, 2015, a UCC financing statement amendment terminating the KMAM, LLC security interest was filed with the Illinois Secretary of State. I understand that this amendment was recorded with the U.S. Patent and Trademark Office at Reel:35078 Frame:851-52 on March 3, 2015.

23. Metrom Rail granted security interests in U.S. Application Ser. No. 13/855,118 to Mark Faber. On July 25, 2013, a UCC financing statement was filed with the Illinois Secretary of State with respect to Faber's first security interest in U.S. Application Ser. No. 13/855,118. On January 2, 2015, a UCC financing statement amendment terminating the first Faber security interest was filed with the Illinois Secretary of State. I understand that this amendment was recorded with the U.S. Patent and Trademark Office at Reel: 35122 Frame:109-10 on March 3, 2015.

24. On July 25, 2013, a UCC financing statement was filed with the Illinois Secretary of State with respect to Faber's second security interest in U.S. Application Ser. No. 13/855,118. On January 2, 2015, a UCC financing statement amendment terminating the second Faber security interest was filed with the Illinois Secretary of State. I understand that this amendment was recorded with the U.S. Patent and Trademark Office at Reel: 35122 Frame:132-33 on March 3, 2015.

25. On August 23, 2013, a UCC financing statement was filed with the Illinois Secretary of State with respect to Faber's third security interest in U.S. Application Ser. No. 13/855,118. On January 2, 2015, a UCC financing statement amendment terminating the third Faber security interest was filed with the Illinois Secretary of State. I understand that this amendment was recorded with the U.S. Patent and Trademark Office at Reel: 35122 Frame: 148-49 on March 3, 2015.

26. Several other security interests were granted in U.S. Application Ser. No. 13/855,118. None of these security interests were recorded with the U.S. Patent and Trademark Office. All of these security interests have since been terminated.

27. As such Metrom Rail is the true and correct owner of U.S. Application Ser. No. 13/855,118 free and clear of any liens and encumbrances.

Chain of Title Summary for U.S. Application Ser. No. 13/644,737

28. On April 12, 2013, the two inventors for U.S. Application Ser. No. 13/644,737 assigned their interest in the application to Metrom Rail. I understand that these assignment documents are recorded with the U.S. Patent and Trademark Office at Reel: 29167 Frame: 969-73.

29. On August 7, 2013 a security interest was executed by which Metrom Rail assigned an interest in U.S. Application Ser. No. 13/644,737 to Mark Strauch. I understand that these assignment documents were recorded with the U.S. Patent and Trademark Office at Reel: 30993 Frame: 990-96 on August 8, 2013. On January 2, 2015, a UCC financing statement amendment terminating the Strauch security interest was filed with the Illinois Secretary of State. I understand that this amendment was recorded with the U.S. Patent and Trademark Office at Reel:35122 Frame:173-74 on March 3, 2015.

30. Metrom Rail granted a security interest in U.S. Application Ser. No. 13/644,737 to KMAM, LLC. On December 31, 2013, a UCC financing statement was filed with

the Illinois Secretary of State with respect to KMAM's security interest in U.S. Application Ser. No. 13/644,737. On January 2, 2015, a UCC financing statement amendment terminating the KMAM, LLC security interest was filed with the Illinois Secretary of State. I understand that this amendment was recorded with the U.S. Patent and Trademark Office at Reel: 35078 Frame: 849-50 on March 3, 2015.

31. Metrom Rail granted security interests in U.S. Application Ser. No. 13/644,737 to Mark Faber. On July 25, 2013, a UCC financing statement was filed with the Illinois Secretary of State with respect to Faber's first security interest in U.S. Application Ser. No. 13/644,737. On January 2, 2015, a UCC financing statement amendment terminating the first Faber security interest was filed with the Illinois Secretary of State. I understand that this amendment was recorded with the U.S. Patent and Trademark Office at Reel: 35122 Frame:113-14 on March 3, 2015.

32. On July 25, 2013, a UCC financing statement was filed with the Illinois Secretary of State with respect to Faber's second security interest in U.S. Application Ser. No. 13/644,737. On January 2, 2015, a UCC financing statement amendment terminating the second Faber security interest was filed with the Illinois Secretary of State. I understand that this amendment was recorded with the U.S. Patent and Trademark Office at Reel: 35122 Frame:130-31 on March 3, 2015.

33. On July 23, 2013, a UCC financing statement was filed with the Illinois Secretary of State with respect to Faber's third security interest in U.S. Application Ser. No.

13/644,737. On January 2, 2015, a UCC financing statement amendment terminating the third Faber security interest was filed with the Illinois Secretary of State. I understand that this amendment was recorded with the U.S. Patent and Trademark Office at Reel: 35122 Frame: 132-33 on March 3, 2015.

34. On August 23, 2013, a UCC financing statement was filed with the Illinois Secretary of State with respect to Faber's fourth security interest in U.S. Application Ser. No. 13/644,737. On January 2, 2015, a UCC financing statement amendment terminating the fourth Faber security interest was filed with the Illinois Secretary of State. I understand that this amendment was recorded with the U.S. Patent and Trademark Office at Reel: 35122 Frame: 146-47 on March 3, 2015.

35. On August 23, 2013, a UCC financing statement was filed with the Illinois Secretary of State with respect to Faber's fifth security interest in U.S. Application Ser. No. 13/644,737. On January 2, 2015, a UCC financing statement amendment terminating the fifth Faber security interest was filed with the Illinois Secretary of State. I understand that this amendment was recorded with the U.S. Patent and Trademark Office at Reel: 35122 Frame: 148-49 on March 3, 2015.

36. Several other security interests were granted in U.S. Application Ser. No. 13/644,737. None of these security interests were recorded with the U.S. Patent and Trademark Office. All of these security interests have since been terminated.

37. As such Metrom Rail is the true and correct owner of U.S. Application Ser. No. 13/644,737 free and clear of any liens and encumbrances.

Erroneously Recorded Lien

38. On October 11, 2013, a lien was recorded in the U.S. Patent and Trademark Office against each of U.S. Patent No. 8,812,227 (U.S. Application Ser. No. 13/474,428), U.S. Patent No. 8,752,797 (U.S. Application Ser. No. 13/310,006), U.S. Application Ser. No. 13/644,737, and U.S. Application Ser. No. 13/855,118 by Michael A. Hierl of Hughes Socol Piers Resnick & Dym, Ltd. as attorneys for Ralph Rybacki. I understand that this lien was recorded at Reel/Frame: 31398-349.

39. The documents recorded as the basis for the liens are in each instance the same and consist of the following:

    a. copies of all four patent application publications;

    b. a Purchase Agreement by and between Metrom LLC and Ralph Rybacki (Rybacki) (May 2010);

    c. a Consent and Waiver by Owner, Landlord or Mortgagee of Real Estate by and between Metrom LLC and Rybacki (July 2010); and

    d. a Bridge Funding Agreement by and between Metrom Rail and Rybacki (prior to July 2011).

40. These liens are improper for at least the following reasons.

41. None of the submitted agreements provide for an assignment of IP rights or a security interest in IP rights. All three Rybacki agreements were executed before any of the patent applications described in this declaration were filed with the US Patent and Trademark Office. None of the agreements grant Rybacki the right to place a lien on any of these future patent applications. None of the agreements grant Rybacki an ownership interest or a security interest in any of these future patent applications. In fact, none of the agreements grant Rybacki any interest in any intellectual property (whether present or future) owned by Metrom LLC or Metrom Rail. For this first reason, the "liens" filed by Rybacki are improper and erroneous.

42. Metrom and Metrom Rail are separate corporate entities. Two of the Rybacki agreements are between Rybacki and Metrom LLC. Metrom ***Rail*** – not Metrom LLC – is the assignee of the patents and applications described in this declaration. Metrom Rail and Metrom LLC are unrelated and separate corporate entities. The two companies are not subsidiaries or alter-egos. For this second reason, the "liens" filed by Rybacki are improper and erroneous.

43. Rybacki has not obtained a judgment against Metrom Rail. In the absence of a contractual clause (which does not exist here, see paragraph 41), it is my understanding that a party must obtain a judgment from a court before it can file a lien against another party's property. In this instance, Rybacki has not

obtained any judgment against Metrom Rail or, for that matter, Metrom LLC. For this third reason, the "liens" filed by Rybacki are improper and erroneous.

44. For the reasons explained above, Metrom Rail is the true and correct owner of U.S. Patent Nos. 8,812,227 (U.S. Application Ser. No. 13/474,428) and 8,752,797 (U.S. Application Ser. No. 13/310,006) and U.S. Application Ser. Nos. 13/644,737 and 13/855,118 free of any liens and encumbrances. The Rybacki liens recorded on October 11, 2013 are improper and should be disregarded.

All statements made herein of my own knowledge are true, all statements made herein on information and belief are believed to be true, and these statements were made with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001.

Date: 6-10-15

James A. Marchi
Chief Executive Officer
Metrom Rail, LLC

AO 120 (Rev. 08/10)

TO:	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK
Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court District of Delaware on the following

☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED	U.S. DISTRICT COURT
	1/13/2022	District of Delaware

PLAINTIFF	DEFENDANT
Metrom Rail, LLC	Siemens Mobility, Inc., Thales Transport & Security, Inc., Thales USA., Inc., Humatics Corp., and Piper Networks, Inc,

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	US 10,778,363 B2	9/15/2020	Metrom Rail, LLC
2	US 8,812,227 B2	8/19/2014	Metrom Rail, LLC
3	US 9,043,131 B2	5/26/2015	Metrom Rail, LLC
4	US 10,737,709 B2	8/11/2020	Metrom Rail, LLC
5	US 10,179,595 B2	1/15/2019	Metrom Rail, LLC

In the above---entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1		
2		
3		
4		
5		

In the above---entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE

Copy 1---Upon initiation of action, mail this copy to Director Copy 3---Upon termination of action, mail this copy to Director
Copy 2---Upon filing document adding patent(s), mail this copy to Director Copy 4---Case file copy